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Western Australia.

GENERAL INFORMATION

RESPECTING THE

PRESENT CONDITION OF THE FORESTS

AND

TIMBER TRADE

1882

S.C.

WESTERN AUSTRALIA.

GENERAL INFORMATION
RESPECTING THE
PRESENT CONDITION OF THE FORESTS
AND
TIMBER TRADE
OF THE SOUTHERN PART OF THE COLONY,

WITH SOME REMARKS AND SUGGESTIONS ON FUTURE CONSERVATION AND
MANAGEMENT OF THE TIMBER AREAS, FROM VARIOUS AUTHORITIES.

WITH A REPRINT OF THE REGULATIONS AND LAWS IN FORCE
FOR THE RENTING OR LEASING OF TIMBERED LANDS.

RHODES HOUSE
OXFORD
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TOGETHER WITH A
REPORT ON THE FOREST RESOURCES OF THE COLONY,
BY
BARON FERD. VON MUELLER,
&c., &c., &c.

Compiled by direction of His Excellency Sir William C. F. Robinson, K.C.M.G.,
Governor of the Colony, and ordered to be published for public information.

PERTH:
BY AUTHORITY: RICHARD PETHER, GOVERNMENT PRINTER.
1882.

TO HIS EXCELLENCY SIR WILLIAM CLEAVER FRANCIS ROBINSON, K.C.M.G., GOVERNOR.

YOUR EXCELLENCY:—

In compliance with your instructions, and so far as the information and means at my command allowed, I have collected in a general way such information about our Timber Forests as was available to me, and I have endeavoured to weave this together somewhat in a connected form.

By including the valuable Report on the Forest Resources of Western Australia, by Baron Ferd. Von Mueller, it will be brought more prominently before the public than it has hitherto been.

The maps included show the position of the Forests and to a certain extent in detail the localities in which the principal Timber Trees grow, and the drawings give a very fair idea of the character of the Jarrah and Karri forests.

When individual authorities are quoted the names are given.

I regret that this compilation is very imperfect, but it may serve now one useful purpose, and to some extent forward the object Your Excellency has in view, by drawing attention to an industry which in the future must be valuable to the Colony, and in those districts where the forests grow doubtlessly the trade in timber must greatly develop, and form the great export from the Southern coast ports.

I have to thank Mr. Harris of the Vasse, who has given much thought to this subject, for his cordial assistance to me, and the Paper he has furnished. I concur with him that the appointment now in the first instance of an official of the character he advises would be beneficial both to the colonial interests and the timber traders, though at the present time the occasion for any extensive and expensive machinery for the management of the Forests is not apparent. No doubt before long some proper organization for forest control must be formed, and the step Mr. Harris proposes now will be one towards this.

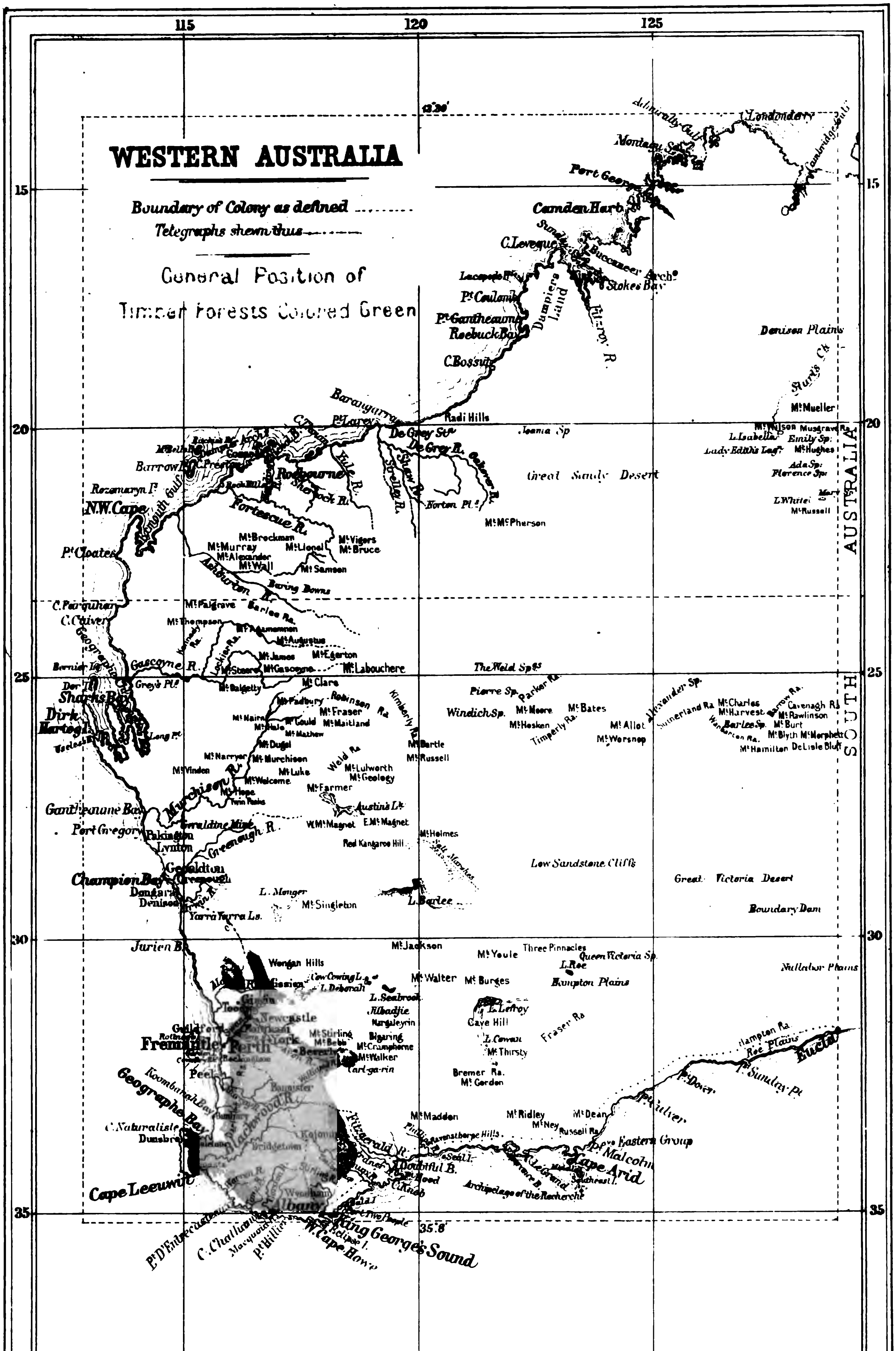
MALCOLM FRASER.

Perth, 9th December, 1882.

SURVEYOR GENERAL:—

I am much obliged for the trouble you have taken in this matter, and also to Mr. Harris for the assistance which he has given you and the Paper he has furnished. I am satisfied that the appointment of an Inspector of Forests and Timber Stations would be a step in the right direction; and the Legislative Council having asked me by Address of the 18th Sept. last to take steps to prevent as far as possible the great waste and destruction now going on in our Timber Forests, I propose as a first measure to appoint an officer whose duty it will be to visit the Stations and to perform generally the duties of Ranger, pending the organization of any more extensive and expensive machinery which may be found necessary in the future.

W.C.F.R.,
22-12-82.



Lithographed at the Surveyor General's Office, Perth, W.A. by C. Woodhouse, Oct. 1877.

WESTERN AUSTRALIA.

General information respecting the present condition of the Forests and Timber Trade of the Southern part of the Colony, with some Remarks and Suggestions on future Conservation and Management of the Timber Areas, from various authorities. With a reprint of the Regulations and Laws in force for the renting or leasing of timbered land.

By the Map of the Colony it will be seen that the Forests from which Timber is now exported from Western Australia are altogether at its South-west extremity, and this is doubtlessly occasioned by reason of the fact that the climate of that part, being subject to the influences of the moist currents of air from both South and North, and being more or less hilly, is more humid and temperate than other parts, as shown by the rainfall of the Meteorological stations now established, which are, however, virtually outside the forests' limits, and therefore really less influenced by the hill rains.

		Annual Rainfall in inches.	Mean Shade Temperature.
North and East of forests.	Geraldton, Champion Bay	16	67°
	York	15	63°
Forest districts.	Perth	33	67°
	Fremantle	30	64°
	Bunbury	30	61°
	Albany	31	59°

The above results are from observations for the years 1880–1881.

The forest area south of the tropics is included within the parallels of south latitudes 31 deg. to 35 deg., as generally shown on the map attached, but very little good timber of any size is found nearer the coast than five to seven miles. As a fact, it may be stated that a belt of forest land exists between the latitudes above mentioned, in some places extending inland for 100 miles, but the best jarrah wood is found in the hill ranges and not nearer than 15 or 20 miles from the coast, and of this the areas occupied by the principal Eucalypti are—

	Square miles.		Square miles.
White Gum *(Eucalyptus viminalis)*	10,000	Tuart *(Eucalyptus gomphocephala)*	500
Jarrah *(Eucalyptus marginata)*	14,000	Red Gum *(Eucalyptus calophylla)*	800
Karri *(Eucalyptus diversicolor)*	2,300	York Gum *(Eucalyptus doxophleba)*	2,400

But on this subject it may be sufficient to quote the opinions of Baron Von Mueller, as given in his Report on the Forest Resources of Western Australia. Of the spontaneous resources he writes thus:—" The forest regions of extra-tropic West Australia occupy an area equal to the whole territory " of Great Britain; and it is singularly fortunate for the Colony that over this vast extent of wooded " country a species of Eucalyptus (the Jarrah) prevails, which for the durability of its timber is " unsurpassed by any kind of tree in any portion of the globe. Under such circumstances the timber " resources must be regarded as among the foremost in importance throughout the wide tracts of

"Western Australia, even if the many other kinds of utilitarian trees occurring in the more southern "portion of that colonial territory, and the more varied sorts of timber trees to be found within the "intra-tropic regions of Western Australia, were left out of consideration. It is furthermore of "particular advantage to the Colony that its highly valuable Jarrah timber is obtainable through, "at least, five degrees of geographic latitude, and this within so short and moderate a distance "of shipping places as to render it easily accessible to foreign traffic." Again—"The wood has attained "a world-wide celebrity; when especially selected from hilly localities, cut while the sap is least active, "and subsequently carefully dried, it proves impervious to the borings of the chelura, teredo, and "termites. It is, therefore, in extensive demand for jetties, piles, railway-sleepers, fence-posts, and all "kinds of underground structures, and it is equally important as one of the most durable for the "planking and frames of ships." And again—"This much can be foreseen, that E. marginata is "destined to supply one of the most lasting of hardwood timbers for a long time to come, at the least "costly rate, to very many parts of the globe." But it is not only the Jarrah which the Baron celebrates among the timber trees of Western Australia; for example, the Karri (Eucalyptus diversicolor), sometimes styled E. colossea on account of its huge dimensions, stems having been "measured 300 feet long up to the first limb, and one particularly gigantic tree 60 feet around at the "base." This wood, he says, is "elastic and durable, and particularly sought for large planks." Again E. oleosa and others he notes for the value of the oil which can be extracted from their foliage—"It "has proved the best known solvent for amber and other fossil resins, and of india-rubber, and unique "in many technologic applications." Nor in considering the utile does he forget the dulce, but records of one species—"Hardly anything more gorgeous can be imagined than the forest of E. ficifolia about "the month of February, when brilliant trusses of flowers diffuse a rich red over the dark-green "foliage of the whole landscape."

To the Eucalypts must be added the Acacias, as well for beauty as utility: A. acuminata, for its richly-scented and coloured wood, for the cabinetmaker and turner; A. saligna, the bark of which contains 30 per cent. of tannic acid; and A. microbotrya, for its enormous yield of superior gum. Of more than 150 acacias standing on record from the hitherto explored portions of Western Australia, he states "that the seeds of every sort would be acceptable for horticultural export trade, Australian "acacias being always in request for European glass-houses." To these must be added the fragrant sandalwood (Santalum cygnorum), the banksias, yielding beautiful wood for ornamental work, and the cypress-pines of the north, valuable for their splendid wood and resin, and which we cannot doubt will soon be utilised for masts, yards, spars, and decks for ship-building, as they have been for rafters, joists, and flooring for houses.

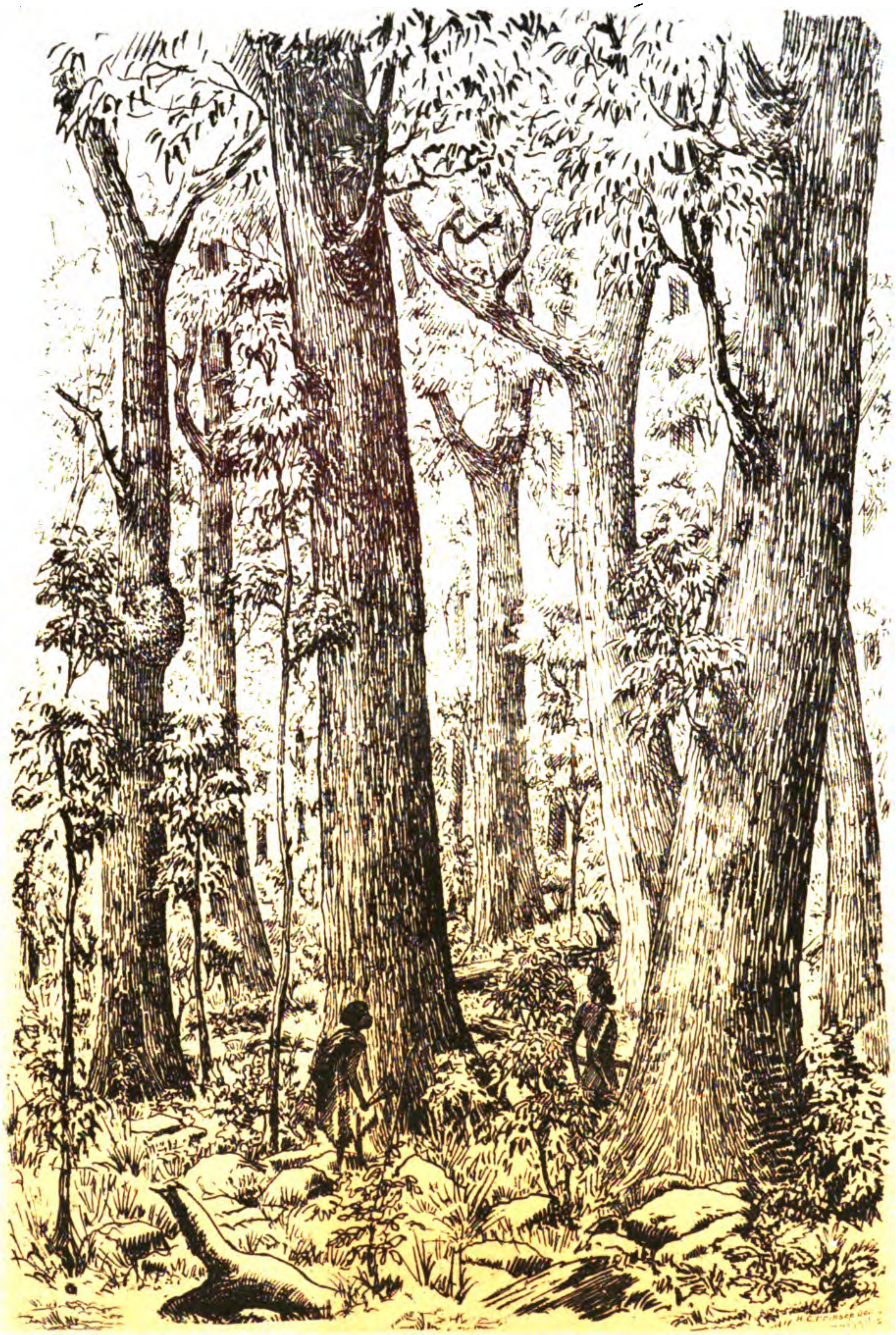
During the year 1871, a report on the quality of Jarrah timber was laid before the Legislative Council. In this report Mr. Manning, who has had a lengthened experience of its value, writes as follows:—

C.S. $^{1}/_{442}$

Convict Department, Clerk of Works' Office,
Fremantle, 10th January, 1871.

SIR,—In compliance with your letter $^{51}/_{775}$ of the 22nd November ult., calling for a Report on the qualities of Jarrah Timber for ship-building, with a view of removing as far as practicable the obstacles existing in consequence of its not being recognised at Lloyd's as a timber for ship-building purposes, I have the honor to state that, from over twenty years' experience with Jarrah, in which time many thousand loads have been used under my direction in Buildings, Sea Jetties, Bridges, and Furniture, in fact in every way in which timber is required in the ordinary wants of life, Jarrah is available, and has been used.

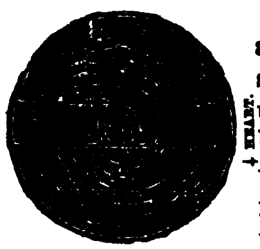
It is strong and dense; its specific gravity being 1·12, but from concurrent testimony of ship-builders it bends freely, and is not deteriorated to any extent by iron fastenings; it does not destroy iron when used in solid timber, and in the repair of old vessels new fastenings of iron, a very little larger than the former ones, are put into the same holes.


H.C.Prinsep del.

WESTERN AUSTRALIAN FOREST
"JARRAH" (EUCALYPTUS MARGINATA)

The tree being an evergreen, there is some difficulty in determining the proper time for felling; as the period of the least flow of the sap is of short duration, it is important that the timber should then be felled.

A peculiarity of this wood is, that it is defective at heart, and the older the tree is prior to falling, the greater the extent of decay in the centre.



The sound timber resists the attack of the "Teredo Navalis" and white ant. On analysis by Professor Abel, it was found to contain a pungent acid that was destructive to life; this principle however, was not found to be present in the unsound portions. Great care is therefore necessary in preparing the wood for use by flitching the log, so as to cut all the defective portions of the heart out, and using only the perfectly sound timber. The sketch in the margin will show the mode of flitching, so as to retain the sound wood, in any required size for all practical purposes. A. B. C. D. E. F. being flitches.

It is remarkably free from the action of nearly all the ordinary forms of decay incidental to woods in contact with or buried under ground, under water, at mortices, or other joinings; in piles, in sea-jetties, and planking of sea-going vessels, without sheathing or other protection, it has proved sound and enduring to an extent which appears to denote exemption from decay, so far as evidence can be derived from observation on timbers exposed for upwards of thirty years.

I have recently taken up piles that were driven for a whaling jetty in the year 1834 or 1835, making a period of at least thirty-five years; the timber is small but perfectly sound and free from insects, although the place is swarming with "Teredo."

My experience here, as also observation on works executed prior to my arrival in the Colony, goes to prove that, if the timber is sound in the first place, there is no fear of decay setting in afterwards, or of its being destroyed by insects; but I would strongly urge the necessity of cutting out all shakes, heart-lags, and defective portions before using.

Very much has been said about the Jarrah being subject to split when exported to India or to England in log. It must be borne in mind that its density renders seasoning very slow, and that the inner portions of the larger trees are in a state of decay even while the outer portions are in full vigor. A tree under these conditions, the inner portion comparatively dry, and the outer full of sap, shipped at once to a hot climate like that of India, or such a variable one as England, very naturally bursts from unequal shrinkage, being also exposed to very great changes of temperature.

To obviate this peculiarity, and apparent defect, let the Jarrah be fallen when the sap is at the lowest ebb, and flitched as previously suggested.

For piles, however, it is important that they should be used round, simply barked, for, as previously shown, the best and strongest wood is the outer portion of the tree. To square a tree for a pile is simply to destroy so many of its annular rings, and detract from the strength of the piece. Timbers for piles, too, are generally of small dimensions, not exceeding two feet diameter, and consequently comparatively young, and not much decayed at heart; in fact, it is frequently seen that there is scarcely any defect at heart in trees up to that size, yet if they are sawn there will be indication of the heart being shaky, so that too much care cannot be taken in this respect.

I have, &c.,
JAMES MANNING,
Clerk of Works.

The Honorable the Colonial Secretary, &c., &c.

Reprint of Papers already published bearing Testimony as to the Suitability of Jarrah Timber for Shipbuilding Purposes.

His Excellency Governor Weld to the Right Hon. Earl of Kimberley.

No. 76.

WESTERN AUSTRALIA.

MY LORD,
Government House, Perth, 13th June, 1871.

In my Despatch No. 67, of 20th May, 1871, I did myself the honor to enclose a report on the fitness of Jarrah Timber for Shipbuilding; and I then requested that Your Lordship would forward the interest of this Colony by laying it before the Lords of the Admiralty should you see fit, and that, if possible, you would obtain that the Jarrah Timber be recognized at Lloyds' as a timber for Shipbuilding purposes.

2. Since then I have received from Professor Ferdinand Von Mueller, C.M.G., a copy of a list of forest trees adapted for cultivation in the Colony of Victoria; and I do myself now the honor to forward to your Lordship an extract taken from that list, in which you will observe that the Professor, a high and impartial authority, speaks in the highest terms of the Jarrah Timber, and states that it is preferred to either Oak, Teak, or any other wood by the Melbourne Shipbuilders. This testimony, emanating from such a source, is so important that I trust Your Lordship will permit me to ask you to lay it also before the Lords of the Admiralty and the Secretary at Lloyds'.

I have, &c.,
FRED. A. WELD,
Governor.

The Right Honorable
EARL OF KIMBERLEY,
&c., &c.

EXTRACT, respecting "Jarrah" timber, from a work by Professor Von Mueller, of Melbourne.

Eucalyptus marginata, Smith.—The Jarrah or Mahogany tree of S. W. Australia, famed for its indestructible wood, which is attacked neither by Chelura nor Teredo nor Termites, and therefore so much sought for Jetties and other structures exposed to sea water, also for any underground work, and largely exported for railway sleepers. Vessels built of this timber have been enabled to do away with all copper plating. It is very strong, of a close grain, and a slightly oily resinous nature; it works well, makes a fine finish, and is by Shipbuilders here considered superior to either Oak, Teak or any other wood. The tree grows chiefly on ironstone ranges. At Melbourne it is not quick of growth, if compared to our Blue Gum *(Euc. globulus Lab.)* or to our Stringybark *(E. obliqua l'Her.)*, but it is likely to grow with celerity in our ranges.

The Right Hon. Earl of Kimberley to His Excellency Governor Weld.

WESTERN AUSTRALIA,
No. 79.

SIR, Downing Street, 15th December, 1871.

With reference to Your Despatch No. 67, of the 20th May, I transmit to you, herewith, for your information, a copy of a letter from the Secretary to the Committee of Lloyds', (6th December, 1871), from which you will learn the Jarrah Timber has been placed by that Society in the third category of timbers to be used for Shipbuilding purposes.

I have, &c.,
KIMBERLEY.

Governor Weld, &c., &c.

[ENCLOSURE.]

Mr. G. Seyfang to Mr. Mead.

Lloyds' Register of British and Foreign Shipping,
2 White Lion Court, Cornhill, E.C., 6th December, 1871.

SIR,

With reference to your letters of the 25th July and 19th August, respecting the suitability of Jarrah Timber for Shipbuilding purposes, I beg to acquaint you that the Committee of this Society have had the subject under their consideration and have determined to rank this timber with those named in line No. 3 in Table A (of which I enclose a copy) attached to the Society's rules for the construction and classification of ships.

I have, &c.,
GEO. B. SEYFANG,
Secretary.

The Hon. R. H. Meade, &c., &c.

TABLE A.

Exhibiting the number of Years to be assigned to the different descriptions of Timber used in Ships; the same to be of good quality, properly seasoned, and free from defects.

	TIMBERING.									OUTSIDE PLANK, &c.				INSIDE PLANK &c.
	Floors.	First Foothooks.	Second Foothooks.	Third Foothooks, and Top Timbers.	Main and Rider Keelsons.	Transoms, Knightheads, Hawse-Timbers, Apron, and Deadwood,* Stem, and Stern Post.	Beams and Hooks.	Knees.	Pall Bitt, Windlass, and Main Piece of Rudder.	From top of Keel to two-fifths the depth of Hold.	From two-fifths the depth of Hold to Wales.	Wales, Blackstrakes, Topsides, and Sheerstrakes.	Upper deck Waterway, Spirketting, & Plank-sheer. ‡‡	Shelves, Clamps, Limber and Bilge Strakes, Ceiling in Hold and betwixt Decks, also Spirketting & Waterway below the Upper Deck.
1. East-India Teak	14	14	14	14	14	14	14	14	14	14	14	14	14	14
2. English, African, and Live Oak, Adriatic, Italian, Spanish, Portuguese & French Oak; Morung Saul, Greenheart, Morra, and Iron Bark	12	12	12	12	12	12	12	12	12	12	12	12	12	12
3. Jarrah, Cuba Sabicu, Pencil Cedar, Angelly, and Venatica...	10	10	10	10	10	10	12	12	10	12	10	10	10	12
4. Other Continental White Oak, Mahogany of *Hard Texture*, Spanish, Chestnut, and Blue Gum	9	9‡	8	8	9	8	9	9	9	12	9	9	9	10
5. North American *White* Oak	8	8‡	8‡	8‡	8	8‡	8‡	7	8	12	8	8‡	7	8
6. Stringy Bark, and Red Cedar	8	8	7	7	8	7	7	7	8	12	8	7	7	8
7. Pitch Pine, Larch, Hackmatack, Tamarac, and Juniper	8	8	8	8	9	8	9	9	8‖	12	9	9	10	9
8. Second-hand English, African, and Live Oak, Adriatic, Italian, Spanish, Portuguese, and French Oak; East-India Teak, Morung Saul, Greenheart, Morra, and Iron Bark §§	7	7	6	6	6	6	6	6	6	—	—	—	6	6
9. Cowdie, Huon Pine	6¶	6	6	7	7	6	7	7	—	10	8	7	10	8
10. Dantzic, Memel, Riga, and American Red Pine	7	7	7	7	8	7	8	8	6‖	9	8	8	10	8
11. English Ash	7	6	5	5	5	4	5	5	5‖	10	4	—	—	5
12. Foreign Ash	5	5	4	4	5	4	5	5	—	8	4	—	—	5
13. American Rock Elm and Hickory	7¶	6	5	5	7	5	7	5	5	12	6	5	5	6†
14. European and American Grey Elm	5	5	4	4	4	4	5	5	—	12	5	4	4	4
15. Black Birch and Black Walnut	6¶	5**	4	4	4	4§	4	4	4‖	10	4	4	4	5
16. Spruce Fir, Sweedish and Norway Red Pine, and Scotch Fir	6	6**	6	6	6	6	6	8	6‖	6	6	6	6	6
17. White Cedar	5	5	4	5	4	4	4	5	—	6	5	4	4	5
18. Beech	6¶	4	—	—	4	—	—	—	4‖	12	4	—	—	5
19. Yellow Pine	—	—	—	4	4	4	4	4	—	6	5	5	5††	5
20. Hemlock	4	4	4	4	—	—	4	4	—	4	4	4	4	4

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* This Table applies to the Deadwood so far as regards the Material to be used from the height of 2 feet above the rabbet of the Keel.

† American Rock Elm allowed for Limber Strakes, Bilge Strakes, and Ceiling between them in Ships of the 8 years' grade and under.

§ Black Birch allowed for Stems and Sternposts in vessels of the 6 years' grade and under.

¶ Black Birch, Beech, American Rock Elm, and Cowdie, allowed for Floors in Midships, to an extent not exceeding *three-fifths* the entire length of the Keel, in Ships of the 8 years' grade and under.

** Black Birch and Spruce allowed for First Futtocks midships, to the same extent in Ships of the 7 years' grade.

†† Yellow Pine allowed for Waterways of Upper Deck in ships of the 8 years' grade, and under, if properly fastened, as prescribed in Table B, and provided the Beams are well secured independently of the Waterways.

‖ The Materials marked thus ‖ under the head of "Rudder and Windlass," allowed in Ships of 300 Tons and under *only*. **MEM.**—The word "English" includes Timber the growth of the United Kingdom.

§§ In cases where second hand timber of the descriptions named in line No. 8 is proposed to be used, application may be made to the Committee, who will appoint a special survey to be held thereon; and on a report being received of its being of superior quality and of adequate size a higher grade (not exceeding two years) may be allowed than as above set forth.

‡ If the First Foothooks run up above the Light Watermark, the use of either of these Oaks will reduce Class by one year. North American White Oak for second and third Foothooks, Hooks, Transoms, Knightheads, Hawse Timbers, Aprons, Deadwood, Wales, Blackstrakes, Topsides, and Sheerstrakes, must be *salted*, or its use for these parts will reduce Class by *one* year.

‡‡ The *inner* waterway of Upper Deck may be composed of East India Teak, Pitch Pine, Larch, Hackmatack, Dantzic, Memel, Riga or American Red Pine, for vessels of any class.

☞ Ships built of the Timber above named, except those built wholly of Teak, will have one year added to their classification, if salted *while building*, provided it be done to the satisfaction of the Surveyors, and as prescribed in Notice No. 265.

Lloyds' Register of British and Foreign Shipping.

Rules and Regulations.

Notice is hereby given, that in pursuance of Resolutions passed this day by the Committee, amendments have been made in the Rules of the Society as follows, viz.:—

Table A for Woods.

Jarrah Timber to be entered in Table A, in line No. 3; thus rating it with Cuba Sabicu, Pencil Cedar, &c.

Rock Maple to be entered in Table A, in line No. 12; thus rating it with Foreign Ash.

By order of the Committee,
George B. Seyfang,
Secretary.

2, White Lion Court, Cornhill,
London, E.C., November 30, 1871.

The following observations in regard to the treatment of Jarrah timber for export are from the pen of a thoroughly practical man, Mr. George Simpson of Bunbury, formerly Managing Director of the Western Australian Timber Company (Limited), &c., &c., and here published with his permission.

How to choose a Jarrah Tree.

If you require timber for permanent works, never select a tree growing on ground lower than about one hundred feet above the sea, nor nearer the coast than eight or ten miles; because trees growing on low grounds and exposed to the strong sea breezes which prevail at certain seasons of the year are generally stunted in growth and often disfigured by bulges and excrescences. The higher the ranges, the better is the timber growing upon them.

You should never choose trees growing on wet alluvial flats, as they are very liable to be "pipey," that is, hollow at the heart for some distance up the stem.

For scantlings never choose a tree less than 3 feet in diameter, for if cut from a small log the end of the scantling next the crown will either be "waney" on the one side, or too near the heart on the other side, or both. Any scantling having heart-wood in it is sure to split more or less when exposed from unequal shrinkage.

Trees having swellings, bulges, and excrescences upon their barrels should only be used for short lengths, so that the part affected may be cut out, for the timber at the bulge is sure to be faulty. These bulges mostly arise from injuries while young, which cause gum veins, etc. Fires are the most fruitful origin of these disfigurements.

Always choose trees with a clean straight stem, and large crown free from decayed branches. These produce the best timber.

The best Jarrah grows on ironstone conglomerate hills, and generally speaking the higher the hills the grander the Jarrah. It does not attain the same perfection on eruptive rocks even when growing at the same altitude as on the ironstone. It grows where it might be supposed that nothing but scrub could possibly flourish, and the roots of Jarrah trees often displace rocks of a ton weight. Where granite appears, Jarrah in some localities is conspicuously absent.

Varieties of Jarrah.

There are three distinct varieties. A botanist might not be willing to admit that this is the case, but the practical sawyer of large experience recognises the difference between these varieties at a glance.

The *Salmon-bark* as its name indicates is mottled like the king of fish. The wood is straw-coloured, close in the grain, and freer from gum veins than Jarrah usually is. The smooth straight trunk rises from thirty to forty feet before branching out, the crown being formed by three or four limbs spreading out nearly opposite each other. This kind yields by far the best wood for planking, and bends readily in almost any way that may be required. I have seen a board of this kind of Jarrah "7 x 1" and 30 feet in length bent into a complete circle, without the slightest sign of breakage.

For ships planking or in any position where tenacity is required this is by far the best kind of Jarrah. It is, however, less plentiful than other varieties.

Another kind is usually called *Plum-pudding-wood* by the sawyers, from its mottled appearance when cut into scantlings. This peculiarity extends nearly all the length of the trunk but becomes less noticeable towards the crown end of the log. Black stripes radiate star-like from the centre; these get gradually fainter as they approach the outside of the log, but are clearly defined and very uniform in the centre. Some trees of this class make handsome furniture, but their timber is generally too dark colored. This variety is much more free to work than either of the other.

The *Rough-Bark* is another kind, its bark is very coarse, and twice as thick at least as that of the *Salmon-Bark*. The wood is dark. The seed pod, leaves, and habits of all Jarrah trees are alike.

Seasoning Jarrah in the Log.

Jarrah cannot by any known process be seasoned in the log. I have tried ringing while the tree was still standing, but that plah will not answer. After being rung the timber gets disfigured beneath the bark by a worm and by the common borer, although neither of these insects penetrate further than about a quarter of an inch into the solid log; the bark falls off in about two years time if the tree is allowed to stand so long, and the wood becomes so hard that it is most difficult to cut it with either the saw or axe. So soon also as the bark falls off, the barrels begin to crack and split, in small slits at first, which, however, soon spread along the trunk for two or three feet and reach a depth of as much as three inches, thus completely destroying the outer and best portion of the wood. I have cut down trees that have been rung for different periods of time, varying from three months to two years, and in every instance, no matter at what season of the year the operation was performed, the result was the same. The inner portions also of the log into which the cracks do not extend, are in precisely the same state as a log newly felled, as sappy or very nearly so, and scantling cut from a log that has been rung two years previously will shrink quite as much as when cut from logs newly felled.

If a log is felled, and kept for any length of time, whether left at the stump in the forest where it grew and where neighboring trees provide a considerable amount of shelter from both sun and wind, or removed to an open space, the ends being protected from the weather in both cases by bark, branches, &c., the result in time will be the same, the logs will not season throughout. A small portion of the outside will be partly seasoned, but will at the same time be spoilt by cracks, while the inner portion will be left almost as little seasoned, as fresh and as moist as a log newly felled, although the outer part of the log may be dried up from the cracks and splits referred to. I once experimented on several pieces of hewn timber 12ft. x 12in. which had been left where they were originally hewn for seven years. I cut them into one inch and half inch boards, and various scantlings. They all shrank precisely the same as those cut from small sized trees, newly felled and brought to the saw.

The only plan I know of to improve Jarrah in the log, is to fell it, without cutting off the *crown*, being careful to cover up the butt end of the log with earth; a man could do this in from ten to fifteen minutes. Leave the bark on the trunk of the tree, and let the log remain as it lies until the leaves have ceased to draw any sap. This will be in from two to six weeks, according to the state of the weather and according to the month in which the tree was felled. Any one can easily tell when the leaves have ceased to draw. If a tree is felled some time during the months of June, July, August, or September, and the crown is left on as directed, the trees containing during those months the greatest amount of sap, the weight of the log will be reduced about three pounds per cubic foot on account of the amount of sap which the leaves draw off. The log is thus seasoned a little, and will not have suffered much from splits during this short time. It should then be cut up at once into the scantlings required.

Seasoning Sawn Jarrah.

As soon as the timber has been cut up, it should be removed to a shed and there stacked to season, laid level and parallel. When the stack is finished, it should be lightly covered with sawdust. This is the best protection possible, and a material always plentiful at a saw mill, light to handle, clean, and easy of application. If the English plan of putting battens between each layer of timber in a stack were adopted, or the scantlings placed in an exposed rack where the air was freely admitted to the timber, it would completely ruin Jarrah in such a climate as this. The seasoning of Jarrah cannot be hurried, time is absolutely necessary to fit it for market, and it must be covered. In large scantlings, and baulks, the gummy nature of the sap causes it to coagulate and prevents the inner sap from escaping, hence Jarrah is never fully seasoned when left in large pieces, no matter how long it may be kept. I cut up and shipped to Adelaide per *Wisteria*, in 1875, several baulks of Jarrah that had been prepared for market by a Mr. Turner twenty-two years before, but for some cause were not shipped by that gentleman. They lay close to the beach, and when I took possession they were overgrown with reeds, bushes, and peppermint trees, and about three parts buried in sand. When cut in two they were quite as sound as the day they were felled, and inside were not seasoned in the slightest degree. They were from twenty to twenty-six inches square. In this Colony there are no middle men—no dealers in Jarrah, to step in as elsewhere between the producer and the consumer, and—purchasing timber from the mills—to prepare it for market. Seeing also that none of the present companies have sufficient capital to enable them even partially to season the timber, there is great difficulty in sending Jarrah to market in a proper condition. The timber should not, properly speaking, be removed from the seasoning stacks until it has been kept for periods varying according to the following table:—

3 x 2	three months
3 x 3	„ „
4 x 3	„ „
4 x 4	four „
5 x 4	„ „
5 x 5	five „
6 x 6	six „
8 x 6	„ „
9 x 6	six months
10 x 6	„ „
12 x 6	„ „
12 x 8	eight „
12 x 9	nine „
12 x 10	ten „
12 x 12	twelve „

The time must vary in like proportion for larger baulks, allowing one month for every additional inch, on the thinner side of the scantlings.

Jarrah seasoned in the open air puts on a grey appearance, showing that the gums are a part of the sap of the timber, and that when the sap is got rid of quickly the gums go with it, the gum in fact is the coloring matter. But when Jarrah is seasoned under saw-dust, the process being slower, it retains its original liver color, while the mere watery parts evaporating, the gum consolidates and in this way aids most materially in seasoning, helping to keep the timber solid on and near the surface.

Seasoning Hewn Timber.

Where young timber has been squared for piles, etc., say 12in. x 12in., most of the young wood has been cut away and little more than heartwood is left, especially next the butt. This is altogether different from sawn timber. In sawn timber, care is taken to avoid heartwood, whereas in hewn there is little else to deal with, and although most of the younger wood which is so liable to tear a log asunder has been removed, still the heartwood is brought very close to the surface of the square, and therefore requires great care to protect it from both sun and wind. Timber of this kind should have at least twelve months in which to season, and, however protected, is liable to split. Jarrah is not really suitable for squaring, but if felled during March, April, and May, and protected for twelve months, it will be fairly well seasoned for all rough carpentry purposes, such as for making wharfs, jetties, etc. To show the necessity for falling Jarrah, especially when young, at the right season, fell a small tree, say one suitable for round or square piles, when the sap is rising and it is in full vigour. After it is felled and lying horizontally upon the ground, cut a recess in its side, well up the barrel, and you will see that as much as a quart of sap will collect in a short time; remove this, and the same quantity will gather again.

Nothing could be more absurd than the statements put forth from time to time in regard to the reason why Jarrah is exempted from the attacks of the white ant, teredo, etc.; some writers in the newspapers actually asserting that the trees should be felled when the sap is at its full flow, as if the sap, which is almost pure water, was what offered resistance to insect life.

Proper Season to cut Jarrah.

The proper season to cut Jarrah once seemed a question buried in mystery, and many letters have appeared from time to time in the newspapers on the subject. The matter has, however, long been settled to my own satisfaction. Whatever ideas others may have, I am quite convinced, for my own part, that Jarrah, although an evergreen, is at times almost, if not quite dormant—I mean during the latter end of the dry season, and that it springs into active life with the first heavy rains, when the sap begins to rise again. I have even found the sap rising about a month after the rainy season has fairly set in, and if the ordinary amount of rain has fallen in May and June the sap will be rising and the tree in its fullest vigour of growth before the end of the latter month. During June, therefore, and July, August, September, October, and November, no timber ought to be felled for exportation, and Jarrah would be better still if felled only in February, March, April, and May.

During the months of June, July, August, and September, the bark can generally be peeled off the whole length of the barrel, by cutting one slit along it and merely inserting the axe between the bark and the log. This is the best evidence you can have as to when the sap rises. As the season advances the flow of sap begins to diminish until the bark can only be got off in comparatively small strips, as it is then adhering to the barrel of the tree, and it continues to get lighter until the rains again set in.

Logs felled, crowned, and barked in the spring if not converted at once into scantlings will tear and split at each end as much as two feet along the barrel, and if left for three or four months, such logs will have to be docked from ten to thirty per cent. It will also be found impossible to save such timber from splitting whether it is hewn or sawn.

On examination it will be seen that even the stumps of Jarrah trees felled in spring split much more than when the felling has been done at the proper season.

(Conclusion of Mr. George Simpson's Paper on the proper treatment of Jarrah Timber.)

Return showing the quantity of Jarrah Timber Exported from the several Ports in the Colony of Western Australia, to each Country, during 1879, 1880, and 1881.

Port from which Exported.	Destination.	Description of Timber.	Number of Loads during		
			1879.	1880.	1881.
Fremantle and Rockingham	South Australia ...	Jarrah ...	3823	4264	5906
	Victoria	Do.	44	1257½	681
	New Zealand	Do.	120	934	...
	British India	Do.	595	...	743
Bunbury	South Australia ...	Do.	3163	2593	3392½
	New Zealand	Do.	823	...	...
Vasse	South Australia ...	Do.	3328	4202	4777
	New Zealand	Do.	413	...	356
	Cape Town	Do.	236	...	...
		Total Loads ...	12545	13250½	15855½

NOTE.—From Albany in 1879 there were shipped to South Australia Posts and Rails of the value of £714 10s.

General particulars of the Timber Saw Mills now established.

Name of Mill and Company or Firm.	Character of Timber.	Length of Tramway or Railway from Mill to Port or Shipping place, in miles.	Number of Engines.	Horse Power.	Not including Teamsters: Approximate number of hands employed.	Approximate produce of Mills per day in loads.	What the Mill could turn out per day in loads.
1.—Lacey's Mill on Eastern Railway	Jarrah	...	1	14	25	5	...
2.—J. W. Wright & Co's. Mill on Eastern Railway ...	Do.	...	2	16	30	...	20
3.—Smith's Mill on Eastern Railway	Do.	...	...	...	...	...	...
4.—Canning Saw Mill, Canning District	Do.	8½	3	50	40	20	...
5.—Buckingham's Saw Mill, Canning District	Do.	...	...	...	...	...	...
6.—Jarrahdale Timber Company, Jarrahdale	Do.	23	2	78	180	40	...
7.—Davies' Collie Saw Mills, Collie River...	Do.	...	2	36	40	12	...
8.—Bunbury Jarrah Timber Company, Ferguson River	Do.	...	...	...	...	...	...
9.—West Australian Jarrah Timber Company, Lockeville	Do.	16½	2	80	80	38	...
10.—Yelverton's Saw Mills, Quindalup	Do.	8½	3	36	30	8	
11.—Davies' Karridale Saw Mills, Augusta and Port Hamelin	Karri	6	3	48	100 to 150	24	... ...

Some years ago there appears to have been in India a prejudice against this timber, principally caused by certain shipments of unseasoned Jarrah having been made, respecting which grave complaints were received. This arose partly from the fact that at that time little was really known of the proper manipulation and selection of trees suitable for timber which would have to undergo the trying influence of a very hot but damp temperature.

In some cases "squared logs" were shipped to India, this being the very worst form in which this timber can be shipped and one in which the timber, it has since been proved, is more peculiarly subject to rending, as the rings remain complete and the rending takes place in all directions, generally on the line of the medullary rays which radiate from the heart. This great drawback to the utility of this wood is at present only somewhat modified by allowing the wood some time to season previous to cutting up; but the various Companies have not the capital to do this to any extent, the orders being as a rule for immediate execution and not limited to well seasoned wood, the result being that a large quantity of timber is shipped immediately after, or within a few months of cutting. There is, however, but little doubt that if greater care was taken in felling trees only during the season that there is the least flow of sap in the trees, the timber would season more rapidly, and thus lessen to a great extent this defect. At present, indiscriminate felling seems to be carried on all through the year, irrespective of any season; and bearing in mind that in some of the timber-producing countries peculiar attention is paid and great stress laid on this point, so much so that wood felled out of season is generally regarded as defective and is rejected by practical men in the trade as unfit for use, it cannot but be taken as a convincing proof that the felling of timber out of season is most undesirable, if not reprehensible.

The White Gum grows generally in all forests, excepting in that part of the Colony where Karri abounds. It is, however, found in the greatest profusion Eastward of the Darling Range. The wood is used for many purposes in the Colony, but it does not appear as an article of export.

The Karri is a tree of extraordinary height, in some cases exceeding 300 feet, and measuring over 25 feet in circumference (one tree is known which measures 60 feet around at the base), being free from branch for a 100 feet of its height. It is of exceptionally tough quality, and has of late years become an extensive export. This timber is confined principally to the country South and West of the Warren and Donnelly Rivers, which outflow on the South Coast.

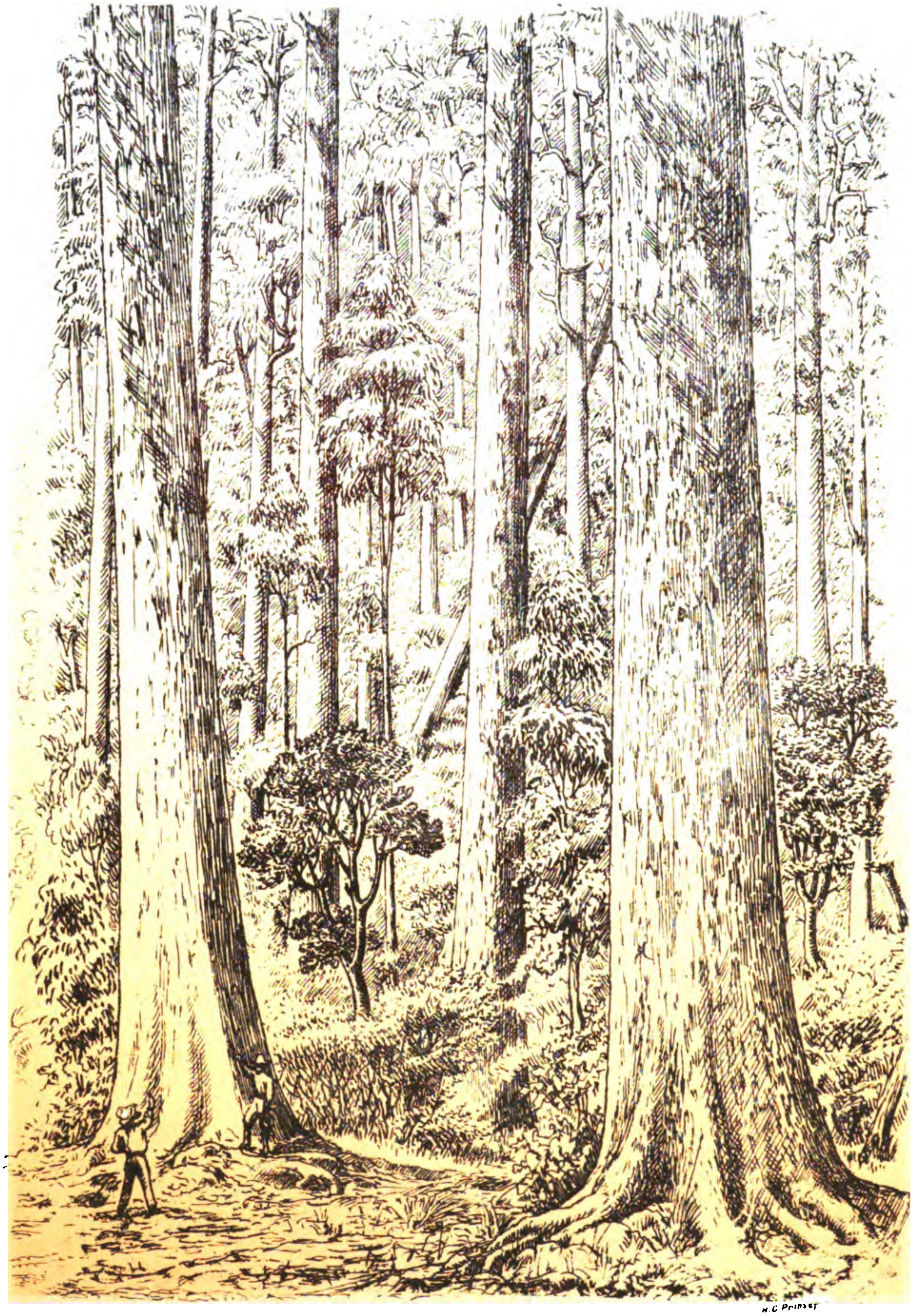
Tuart timber is extremely hard, twisted and curled in the grain. It is very valuable where great strength is required for shipbuilding, combing of hatches, engine-bearers, framing for railway carriages, carriage-wheels, &c. It shrinks very little in seasoning, and will not split during the process. It has been known to be exposed over thirty years without being affected, and it is the strongest timber known. Large size planks and scantling, from 20 to 40 feet long, and 2 feet wide, can be cut from this timber.

The Tuart is only found growing on the limestone coast ranges, one or two miles from the sea; is not found South of Vasse, Geographe Bay, or North of Cockburn Sound; in fact the Murray River may be taken really as its northern limit.

Table showing Comparative Tests of Indian Teak and English Oak compared with Western Australian Tuart, Jarrah, and Karri Timber.

Name of Wood.	Weight per Cube Foot.	Specific Gravity.	Transverse Strength per Sq. In.	Average Tensile Experiments.			Vertical or Crushing Strains on Cubes of 2 Inches.	No. of Years Assigned by English Lloyd's for Shipbuilding purposes.
				Dimensions of Each Piece.	Weight the Piece Broke with.	Direct Cohesion on 1 Sq. Inch.		
	Lbs.		Value of S.	Inches.	Lbs. per Sq. Inch.	Lbs. per Sq. Inch.	In Tons per Sq. In.	
Indian teak ...	49·47	807	2203	2 × 2 × 30	13,207	3,301	2838	14 years
English oak ...	31·72	886	2117	2 × 2 × 30	30,287	7,571	3411	9 „
Tuart	73·06	1169	2701	2 × 2 × 30	40,487	10,284	4195	—
Jarrah... ...	63·12	1010	1800	2 × 2 × 30	11,760	2,940	3198	12 „
Karri	61·31	981	2264	2 × 2 × 30	28,280	7,070	5140	12 „

Sandalwood has for some years past contributed largely to the productive industry and profit of the Colony; but unless new plantations are found it cannot very long continue to do so, as the distance which even now it has to be carried to the ports of shipment raises its price so much as to leave no great margin of profit.



WESTERN AUSTRALIAN FOREST

"KARRI" (EUCAL^{s} DIVERSICOLOR)

The principal ports from which shipments of timber are made are Fremantle, Rockingham, Bunbury, Lockeville, Quindalup, Hamelin, and Augusta.

The amount of capital invested in the various Companies now at work, the large extent of forest land leased and specially licensed for terms of years, the numbers of men employed, and the impetus given thereby to other local industries and commercial undertakings prove the desirability of a careful consideration of the timber trade, with a view of aiding and further developing this gradually increasing and highly important industry.

The difficulties that the various Companies have to contend against consist principally, if not entirely, of those connected with the length of transport to the port of shipment, and the want (in some of the ports) of larger jetties. The first can only be remedied by the laying down of tramways, thus entailing the expenditure of a large amount of capital. Most of the Companies are, however, gradually and considerably adding to the length of their respective tramways.

The Government, in 1870, as an inducement to a Company to establish itself in Geographe Bay, granted terms which it might be urged have since proved in some degree unsatisfactory. This should not, however, militate against the granting of leases containing concessions concurrent with the bonâ fide fulfilment of engagements for the performance of certain work on the part of the lessee.

A further difficulty the trade has to contend against is the delay caused in the shipment of timber, owing to the distance of lighterage to the ships, which, from the open and exposed nature of most of the roadsteads or harbors, are compelled to anchor at a considerable distance from the shore. It also appears, as has been before remarked, that greater jetty accommodation is urgently required at some of the ports of shipment. This latter want is a matter for the Government to deal with, being a question entirely whether such expenditure would result in a proportionate return of revenue. The subject is one, however, deserving of special attention. Besides the timber transport over roads and tramways, a certain quantity finds its way to the coast by water carriage; but unfortunately the Colony is lamentably deficient in this respect. The only rivers of sufficient navigable depth which in any way tap the timber country are the Canning, which flows into the estuary of the Swan, the Blackwood, which empties itself into Flinders Bay. The former is, however, encumbered in many places with mud banks upon which, in summer, it is no uncommon occurrence for lighters to run aground and be delayed for days; the bar in Fremantle is also in bad weather a cause of unavoidable delay. The Blackwood has as yet been so little used as a means of transport that nothing is really known of its advantages in this respect.

Considerable difference of opinion seems to exist respecting the advisability of the appointment of a Government Officer, whose duty it should be to inspect and brand all shipments of a certain quality. With some persons interested in the trade, such an appointment is looked upon with favor, as it would secure the shipper from the caprice and petty complaints on the part of purchasers at the port of discharge; and such a guarantee would facilitate banking negotiations in this Colony; it would also probably ensure the shipment of a better class of timber. Others, however, consider that it would act most unfavorably upon the spirit of emulation and enterprise, which must naturally exist in every branch of commerce or manufacture, and, instead of fostering and encouraging such a spirit, it would merely act as an embarrassment. The following terse reply was given to inquiry by a gentleman well versed in all the matters connected with this business:—"If the spur of emulation to secure "approval of customers be not effected by the spirit of enterprise, it will never be accomplished "through government interference." The majority of those consulted, respecting the introduction of some such system, was decidedly against its adoption. At some future time, it might answer to appoint an official of practical experience, whose duty it would be to visit and report periodically upon the state of the various forests where felling may be carried on, with the view to the conservancy of the timber forests and for the prevention of wanton destruction of trees, as well as for the supervising the planting of saplings in place of trees cut down; and this might be arranged in such a manner as to interfere as little as possible with the working management of the various companies, and yet at the same time ensure the cultivation of a succession of young trees in place of the timber cut down. This proposal is open for discussion. As an instance of the rapid growth of this class of Eucalypti, it is only necessary to mention a fact:—One firm was lately cutting down timber over ground which was completely exhausted of all large trees some ten years back; the small, and at that time unsuitable trees, having since reached maturity, were able to furnish logs of an equal size to those previously cut.

Whilst dealing with this subject of conservancy, it may not be out of place here to refer to the report forwarded to the Secretary of Agriculture, Victoria, by Mr. W. E. Ivey, Chemist, Department of Agriculture, for the year 1874-1875, as many of the remarks contained therein are peculiarly applicable to this Colony as well. The following are extracts from this report:—"Much valuable "timber is wasted also in consequence of its first small cost to persons using it and of the "disproportionate high price of labor; for where the value of a standing tree is to a licensee equal to "but a fractional part of the cost of felling it, and when the cost of felling is equal to but a small "portion of the cost of delivery at the mill, and that it costs as much to handle a decaying tree as a "sound one, it is not to be expected that sawmillers will go to the expense of hauling to the mill an "unsound tree when they can get a sound one that will yield many hundred feet more of timber for "the small additional outlay of the cost of felling.

"The same reasoning applies with even greater force in the case of the splitter, who, should he "have felled a badly-splitting tree, reckons whether it is more advantageous to work up the tree felled "or to fell another. In all such cases it is a simple matter of calculation of the value of the labour that "must be expended that guides the saw miller or splitter, the amount of the license fee being the same, "whatever number of trees he may fell during the period, for which his license gives him authority "to fell.

"With respect to the management in the immediate future, I beg to offer a few suggestions, pre- "mising that they must be considered as put forward as being calculated, in my opinion, to pave the "way for the gradual introduction, as the country becomes prepared for its administration, of a "thorough system of forestry. In the first place it will be necessary to classify all reserves, to decide "which are to be retained permanently, and for what purpose, viz., for the supply of what class of "timber. This done, and those reserves to be included in the first class, to be termed "State Forests," "having been selected, their capabilities estimated, and the quantity of timber that each could supply "annually, without becoming gradually impoverished, determined, it will be necessary to consider "what methods will be best adapted for

"(1) Control of the cutting of timber and its restriction within prescribed limits.
"(2) The prevention of waste of timber.
"(3) The protection of immature trees.
"(4) The reproduction of timber.

"It is evident that should there be an excessive demand upon any forest for timber, the only way to "protect it from destruction is to restrict the cutting within proper bounds, by preventing the cutting "of more than a certain quantity of timber annually.

"Perfect control over the timber supply would be obtained by selling just such a number of trees "as the forests would yield without diminishing the stock of timber. Pending the general introduction "of this system, cutting under license should be restricted to certain portion of the forests, and the "number of licenses authorised to cut over any such portion should not be greater than would be "sufficient to fell the amount of timber the forest is estimated to produce annually.

"When such portion of a forest has been denuded of mature trees it should be closed from all "entry, for say ten years or longer, as might be determined, and another portion of untouched forest "thrown open for cutting.

"In Europe, most of the difficulties we experience are obviated by cutting the timber and selling "it outside the forest, or, if sold standing, each tree is marked, or the timber upon a specified area is "sold outright.

"The prevention of the waste of timber would appear to be an especial difficulty to be overcome "in some of the more distant forests. The extent to which timber is destroyed in an Australian virgin "forest it may be observed is often apparently greater than it is in reality, and a visitor familiar with "European woods is very apt on a first inspection to estimate the waste to be much greater than is "actually the case. Many trees in these primeval forests have arrived at maturity years since, and "are now in different stages of decay, whilst in some forests the operations of wood-boring insects "render valueless many apparently sound trees. These causes increase the apparent waste of "timber. Still, making every allowance, there is great waste in all our forests. Enforcing the "using up of all trees felled can be carried out to a considerable extent, and will materially lessen this, "but no measures that can be devised will at present ensure the complete utilisation of timber, except "in forests so close to a market that it will pay to use up inferior timber, and to carry for firewood "top and lop portions of trees valueless for other purposes.

"The present licensing system is susceptible of great improvement, and by gradually bringing "areas under better control, it might be used to pave the way for the introduction of a system better "calculated to meet the requirements of the future.

"By restricting cutting to certain localities all matured trees would be cut, and then would cease "to exist the present reprehensible and wasteful practice of taking a young growing tree and leaving "a fully matured one (as not being quite so valuable for saw mill purposes).

"The result of this practice is that the matured tree becomes yearly of less value, and possibly of "none by the time the part of the forest where it stands is again gone over, in consequence of the "exhaustion of the previously untouched portion of the forest of choicer trees having rendered it "necessary to accept trees of inferior value that had been before rejected.

"We must rely upon natural reproduction, selecting trees for felling as they arrive at maturity, and "rendering every assistance, and affording sufficient protection to nature in her efforts to restore our "forests. It is true that forest land treated in this manner will not yield as much timber per acre as "planted forest; but it cannot be disputed that with cheap land and timber standing in the forest at "such a low price it would be unwise to attempt at a great cost to convert our indigenous forests from "natural forests into plantations. It would be better to devote a larger area of country to the supplying "of our wants, employing a small portion of the labour that would be necessary to plant in putting in "force vigorous, preventive, and protective measures, and thus conserve our timber supply."

Captain Campbell-Walker, Conservator of State forests, New Zealand, in a paper read before the New Zealand Institute, Wellington, made the following remarks upon the financial aspect of forest conservancy. After dwelling upon the climatic advantages of the maintenance of forests he goes on to say:—"Let us now consider the financial aspect of the question. The question of direct "financial gain or extracting a revenue from the forests by the State, should ever be subordinate to "their conservancy for climatic considerations and improvement, to meet the demands of the future. "So long as this is borne in mind, and we are not tempted to overdraw and trench on the capital as "well as the income of our forests in the shape of timber and minor produce, there is no reason why "they should not be dealt with like any other property, nor why the State, as proprietor in trust for the "public, should not derive from them the maximum amount of revenue compatible with the general "welfare of the people.

"No one in his senses would propose to reserve and keep permanently locked up, either for "climatic considerations or prospective money value, one tithe of the forests of this Colony as they now "exist. Time and exploration, and selections on a definite system, can alone show what we should "keep and what may be parted with; but I may say broadly, that probably nine-tenths of the existing "area under forest in New Zealand may in time be cleared away, or at least not specially reserved and "devoted to the growth of timber. I propose that Government, viz., the public should claim and take a "fair share of the value of the timber remaining on the waste lands of the Colony and not allow it as "has been almost universal heretofore to be monopolised solely for the benefit of individuals or still "worse wasted and destroyed."

The following very able and exhaustive article on the subject of forest conservancy was published in *The Australasian*, of 22nd March, 1879, with respect to the timber forests of Victoria:—

"FORESTS, AND WHAT WE OWE TO THEM.—The different standard of intelligence exhibited in the "administration of the Imperial Government and that of our own could hardly be more strongly shown "than by the fact that the Home Government has recently gone to great trouble to obtain and analyse "complete returns regarding the condition of forests and timber supply in the Colonies, and now has "published them, just about at the time when our own Government has entered on a course that will "lead to the destruction of our poor attempts at forest conservation just to placate one or two political "loafers and to secure one or two hireling votes. In the returns we refer to copious evidence is "supplied of the ruinous destruction that is going on, and its reckless effects. In some prefatory "remarks prefixed to them reference is made to cases where 'strong and well-established Governments "'look on supinely while the timber is disappearing and the whole country is becoming treeless and "'bereft of the shade so necessary to health, and even to existence in tropical climates.' We are "further told that 'in some cases something little short of a meteorological revolution has been caused "'by the extermination of the woods. Streams once regarded as perennial now run dry under "'exposure to a tropical sun, and the periodicity of the rainfall has been seriously disturbed in many "'localities. So many testimonies converge towards the establishment of a connexion between rainfall "'and forest area that it is difficult to resist the conclusion that much which is gained by throwing a "'little more forest land into cultivation is lost in the lowered fertility and the disturbance of the "'climatic equilibrium of the whole District.'

"If anything were required to add weight to the important testimony and serious warnings which "have been published upon this subject, it is supplied by the fact or, we will say, the probability that a "cause is already at work in the same direction which is laying waste vast regions of the earth's "surface—a cause which we cannot in any way remove, and in regard to which we have only to choose "between co-operating with it, or striving to mitigate its effects. Some very extensive and significant "evidence was collected some years ago by Professor J. D. Whitney, and published in the *American* "*Naturalist*, to show that large tracts upon the face of the earth were undergoing dessication, that there "has been, and is still proceeding, a great decrease of water on the earth, and that, if this process "continues without limit, we are in danger of drying up. Observations in Central Asia, in Kashmir, "in Thibet, point to a great dessication in those regions. Where great mountain lakes existed there is "now nothing but arid valleys. At no distant time, geologically speaking, the valley of Kashmir was "occupied by a lake. Even within historical times, the area covered by water in the basin of the "Aral and Caspian seas has immensely diminished. In Africa ruins found in the great Libyan desert "testify to great changes having occurred within historic times. Readers of Dr. Livingston's travels "will remember the evidence he so often cites of a rapid drying up of Southern Central Africa. In "the great basin west of the Rocky Mountains, North America, in which the Great Salt Lake lies, "there are terraces surrounding the lake to prove how much greater area it occupied in earlier times. "In many other parts, such as Arabia, Persia, and even in Europe, there is cogent proof supplied that "the quantity of water is much less than it was at earlier, and not always very remote periods. These "effects are in many cases altogether too vast to be attributed to any destruction of forests, even were "there proofs that such forests had ever been destroyed. We seem to be thus brought in face of the "formidable phenomenon of a gradual and most extensive dessication of the surface of the earth "without any means of estimating to what extent it will proceed, and what, if any, will be its limit. "And if this is so we have to choose between co-operating with this influence by destroying as rapidly "as possible the forests which oppose this dessication, or to endeavor to counteract it by carefully "preserving these as invaluable bulwarks against a terrible foe.

"Let us now give a glance at what mankind have done, and are doing, in regard to these "alternatives. An article by Mr. F. L. Oswald, in the *North American Review* for January, gives a "telling summary of some of the leading facts which answer this question. The writer, after sketching "the evidence proving the wholesale destruction of forests in the countries surrounding the Mediter-"ranean, in the course of which he states that 'since the beginning of the 16th century the population "'of the four Mediterranean peninsulas has decreased more than 55 millions,' and 'the rate of the "'decline from year to year bears an exact proportion to the decrease of the forest area of every "'District,' proceeds:—

"'Afghanistan, Persia, Mesopotamia, Syria, Asia Minor, Greece, Macedonia, the Southern islands "'of the Mediterranean, and the whole of Northern Africa, from Cairo to the western extremity of "'Morocco—countries which were once blessed with abundance and a glorious climate—are now "'either absolute sand wastes or the abode of perennial droughts, hunger, and wretchedness; and "'wherever statistical records have been preserved, it is proved, beyond the possibility of a doubt, "'that their misfortunes commenced with the disappearance of their arboreal vegetation.'

"He goes on to show that in the western hemisphere the forest area has during the last 45 years "decreased at the average rate of 11,400 square miles annually. In the United States the rate has "advanced from 1,600 square miles in 1835 to 8,400 in 1876. 'We have,' he says, 'been wasting "'the moisture supply of the American soil at the average ratio of 7 per cent. for each quarter of a "'century during the last 125 years, and are now fast approaching the limit beyond which any further "'decrease will affect the climate phenomena of the entire continent.' There is much that is "suggestive and significant, if also something that is rather fanciful, in the sentence, 'The treeless "'regions of America lie chiefly in the west, those of Africa and Arabia in the north, of Europe in "'the south-east, and of Australia in the north-west; and the theory that all deserts on the face of "'our globe have been produced by the hand of man is therefore, supported by the remarkable circum-"'stance that the most barren portion of four continents are found *on the side turned towards Asia*, and "'which, according to all geographical and ethnological probabilities, must have been first reached by "'the waves of emigration which emanated from that common home of the human race.' The writer's "fancy again finds play in the observation, 'But the interest we should take in the preservation of our "'woods might rest on even a broader basis than their agricultural importance. That man was not created "'in a desert, nor in a cotton field or a city, but in a forest, is one of the few points in which Moses "'and Darwin agree; and, with our forests, we would lose their health-giving atmosphere, the music "'of their song birds, the purest enjoyments of our early years, and nature's remedy for the mental "'discords of mankind. Woods are the native life-element of the human race, and a home-sickness, "'an instinctive yearning after the garden home of our forefathers, haunts the nomad of the desert as "'well as the inhabitant of luxurious cities.'

"It is not necessary for emphasising the immense importance of preserving a proper proportion "of forest to linger on considerations such as these. Not that they are at all trivial. They are of "great weight, and there can be no question that, even if it were possible without material injury to "turn the whole land into a cornfield or a pasture, it would still be well in the interests of harmony and "beauty, and their cultivating and soothing effects, to retain tracts of woodlands that might present to "civilised man glimpses of the primeval nature he has quitted. But in comparison with the tremendous "issues involved, not to the well-being, but to the very existence of mankind, these considerations "become relatively of slight moment. The real question for a community settled in a new land to "consider is, does it desire to retain the country as a home for future generations, and to preserve the "climatic conditions, and the natural balance of forest and champaign by which it is fitted to sustain "and nourish human life, or does it rather contemplate becoming a locust visitation to the land, "destroying its wealth, rifling its resources, stripping it of its fertility, and leaving it poorer to each "successive generation, until it finally remains a desert spot on the face of the earth, unfitted for ever "to sustain vegetable and animal life?"

There can be no doubt that the preservation of the forests is a matter of considerable importance to the future of this Colony; nor is there much doubt that very great waste is taking place every day; but at present the untouched forest area of the Colony is so great that no anxiety need be felt as to the supply falling short for very many years to come. Still it might be of very great advantage to the Colony if a scheme of forest conservancy, more particularly for the prevention of wilful waste, or wanton destruction by fire, and the protection of young trees, was organised. But as regards the establishment of a forestry school for the purpose of fostering plantations in places where the ground may have been cleared of timber, the time has not yet arrived for an expensive scheme of this nature entailing the maintenance of a large staff, and necessitating the imposition of some tax upon those engaged in this industry, such as an export duty on timber, to cover the expense, for any export duty would greatly hamper a branch of commerce which is as yet only in its infancy, although at present in a more prosperous condition than it has been for some years.

There are divers opinions about the character of conservatory measures required, probably what may be desirable are—To regulate the time during which trees should be cut down when there is least sap or fix their minimum dimensions; provide for the nurture of young growing timber; provide for burning off branches and debris of fallen trees at a season of the year when fires will not spread. To carry out any regulations there must be a staff of Rangers and Inspectors, without which they will be a dead letter, and this staff will be more or less costly if efficient.

Mr. Randell, M.L.C., of this Colony, has thus written on the subject:—"It does appear to me "that it would be a step in the right direction if a permanent board were established with full power "in all matters relating at any rate to the conservation of the present and the planting of new forests, "funds being placed at their disposal, in some such way as is now done in South Australia. This "board will be able to make regulations as to the size of the trees which should be cut, also as to "protection of the timber areas from the damaging effects of fire, and the wanton waste of timber. "It would also be able, to some extent, to undertake the planting of trees, and the encouragement "of persons desirous of doing anything in this way. It has often been publicly stated that our timber "is practically inexhaustible, but as I do not accept this statement as the truth I feel that steps in "the direction I have above indicated cannot be too soon taken. Great waste is, I believe, taking place "constantly. I think the time has also arrived in which a small export duty should be levied upon "all exported, the funds derived from which should be applied to the purposes of conserving and "planting."

The South Australian Government seems to have seriously considered the question, and one of their authorities thus writes upon the subject:—"Putting aside altogether the subject of the influence "of forests upon a climate, and looking upon this matter in the light of public utility alone, the "conservation of the forests demands the best attention of the Government of any country. This I "may say is particularly the case in those countries which are devoid of a supply of coal for fuel and "other purposes. However much it may be desirable to convert the forests into a source of revenue, "this at first should be considered of secondary importance to the permanent good which will "undoubtedly result to the country at large from the systematic conservancy of existing and the "planting of new forests in it. Individuals are too much engrossed in the management of their own "affairs to become so philanthropic to shape their actions in order to secure a permanent benefit to "future generations. This then is unquestionably a matter for the consideration of the State, and the "aim should be to so establish a system of forest administration in the country that the products from "the forests will at all times, both at present and in the future, be able to more than meet the "demands for them.

"Again, another strong argument for the matter of forest administration being taken up by the "State is that so long as the Government of the country shows apathy regarding the subject, so "likewise will the individual community be indifferent in the matter; but so soon as forest conservancy "forms a part of the administrative policy of the Government, and the result is seen to be a more "certain supply, and it may be a much more valuable class of timber to the country at large for "general purposes, then the matter will be taken up by private individuals, both as a means of "speculation and for the purpose of ameliorating the general appearance of their properties."

GENERAL NOTES ON TIMBER AND FOREST PRODUCTS, WITH REMARKS, BY MR. J. S. HARRIS, LATE RESIDENT MAGISTRATE, VASSE.

The various Localities in which the useful Timber Trees of West Australia are to be found.

The Jarrah ranges extend a distance of about 250 miles along the "Darling Range," some 20 miles from the coast, varying in width from 40 to 100 miles. This timber improves in size as it enters the Southern Districts and is perfect in the Blackwood, Donnelly, and Warren Districts. The more rocky, the more iron-stone, and the higher the range the better the quality, and the greater the durability of the timber. Scattered in these Jarrah forests will be found the Black-butt, North and South, at all distances, growing in patches of 100 to 200 acres, as at Baylup (Toodyay Road). On the Serpentine, &c., single trees are also found mixed with the Jarrah trees.

The Karri is found growing South and South-west of Busselton, within 40 miles of Albany. These forests appear to be inexhaustible, many trees containing 10 to 16 loads.

The Salmon Bark Jarrah is found on the ranges South of Busselton, at a distance of 14 miles, grows in a rich iron-stone soil occasionally rocky.

This tree is not as yet much used, exceedingly tough, hard, and with care free from splits. It is believed to be superior to Tuart, or in fact any of our timber.

Tuart is found growing on the Southern coast from the Murray River, extending a length of 70 miles and a width of from 1 to 3 miles. A splendid timber useful for indigo presses, railway trucks, carts, carriages, and ship's beams, is exported to India, Adelaide, and England, is very hard, close grained and tough, similar to "Box" but more durable.

York Gum is found in all parts of the Colony but more especially in the Eastern Districts. The trees are scattered along the rivers and water courses on rich or poor soils. It is a useful timber, more especially in the manufacture of wheels.

If steamed it will last for 20 years and even then scarcely a crack or crevice can be seen that would admit the point of a penknife.

The "Wanda," a sort of Stringy Bark Tree, very short, twisted like a corkscrew, similar to Lancewood, and used for shafts for traps and carts, is also found East of York in abundance.

Red Gum of West Australia.—This tree is found growing in most parts of the Colony, commencing at the Hill River in the North and extending South to the Hay River. It is occasionally found in small patches growing East of the Darling Range, and generally scattered through the ranges mixed with the Jarrah and Karri, on the plains within 20 miles of the coast. It is to be found in large quantities on the coast plains in the Southern Districts following the small streams into the ranges. It delights in a deep porous soil filling the deep glens and hill sides; it will grow in stiff clay and sandy loams; it delights to grow in the neighborhood of rivers, lakes, and swampy ground.

It attains a height of 40 or 50 feet, has large branches loaded with dense foliage affording a splendid shade. The gum exuding from the trunk of this tree is worth £25 per ton and is caught in buckets and casks during the summer months. The bark forms a rich red soil. The timber is not at present in much use, but is occasionally employed in making spokes, naves, axe handles, and rails, but is unfit for posts or underground work as it is easily impregnated by the White Ant and is decidedly not a lasting timber. It adds very much to the beauty of the scenery of the Southern Districts, cooling the atmosphere.

To live in a Red Gum forest is to be healthy.

The young trees grow with great rapidity.

Sandalwood is found in every part of the Colony South of Champion Bay, at an average distance of 50 miles from the coast. In the Northern Districts of the Colony it extends to the coast. East of York and Toodyay it is found in thickets two to three feet high, which when injured by fire has the appearance of a field of gold.

The Jam Tree is found extending from the Gordon River to Champion Bay; it is highly scented, makes beautiful furniture, grows to a height of eight or ten feet, throws off an unusual amount of seed; the natives make flour and bread of the seeds, cattle and sheep feed on both seed and husks, and rest under the shade of its branches in the hot summer day.

At present both steam and horse-power is employed in the conveyance of timber from the Darling Range.

From the ranges at York Green Mount, six miles from Guildford, horse-power is employed. From Guildford to Fremantle steam-power or water carriage.

From the Canning Ranges to the Canning River, horse-power on a tramway, some 14 miles in length, is in use. From the Canning River to Fremantle, water carriage.

From the Jarrahdale Timber Station at Rockingham, 25 miles of steam power is employed. This company possess a powerful engine, and the line is well laid with steel rails. The logs are conveyed to the saw mill by horse-power. The company have a jetty alongside of which large ships are easily and speedily loaded. The plant, railway, and port of Rockingham are decidedly the best in the Colony.

The Collie Mill Station, about 25 miles from Bunbury, the property of M. C. Davies. The timber is conveyed from the mill by horse-power. Some excellent timber has been exported from this mill in both scantling piles and railway sleepers. The Jarrah is found growing on the ironstone ranges. No doubt at present horse-power is advisable, until the back country is properly surveyed and the timber ranges described, both as to the extent and nature of timber, a railway would be premature.

The Bunbury Jarrah Timber Company have fixed a mill some 23 miles from Bunbury. The Jarrah in the neighborhood of this mill is said to be very sound and good. The timber is conveyed by horse-power to Bunbury. Ships during the Summer season can lay alongside the jetty there with safety.

The Western Australian Timber Company's mill is 5 miles from Busselton, and erected on the Vasse Inlet. The mill is on a large scale, the timber is conveyed by steam-power some 15 to 20 miles from the range. The railway is in fair working order, some portions very good. The cut timber and piles are conveyed to the ships in cargo boats. The ships anchor from 1 to 3 miles from the jetty, which is supplied with a substantial crane.

The Station at Quindalup, owned by Mr. Yelverton, is 10 miles from the coast; has a tramway on which the timber is conveyed by horse-power. It is in fair order and under its present energetic owner and manager we may expect a steady increase of trade.

Davies' Station, Flinders Bay and Hamelin Harbor.—The timber is conveyed to the mill by horse-power. The timber supplied is Karri which can be obtained in lengths from 60 to 150 feet. The timber is shipped by cargo boats. The Blackwood River at Flinders Bay can with but slight difficulty be made navigable for a distance of 30 miles. A steam tug would be of much value both in the conveyance of timber to the coast and shipping the same.

Forest Products—Wattle Bark—Gums—Charcoal.

WATTLE BARK.—At present the trade in this is by no means extensive here, but the Colony is eminently adapted for its production, both in respect of soil and climate. The trees are of very rapid growth, and many thousands of acres may be found in almost every district in the Colony suitable for plantations of this valuable race. The wattle tree also produces a gum (though not in large quantities), recommended by the medical faculty for its strengthening properties.

GUMS.—Are found extensively in the Eastern Districts, especially on the Williams and Avon Rivers and the Toodyay and Victoria Plains. The gum is collected by men, women, and children, also by the natives. The latter collect this gum, which is edible, and bake it into cakes for future use. The trees continue to exude the gum for some 3 or 4 months in the year. It is very pure and clear and is found in lumps of from one to three ounces in weight. Many of the trees produce in the season as much as 2 pounds of pure gum. The employment of this gum in England needs no comment.

Manna gum is found on portions of the coast west of Bunbury. It is little inferior (if at all) to the manna of commerce and is used as food and for other purposes.

Blackboy gum exudes from all parts of the stem to the root of the tree in considerable quantities. It is very hard, dark, and durable, and is employed for many purposes—for stopping leakages in water troughs,—as a dye, and as a cement. The rushes of the tree are used for thatching and will stand the wear and tear of years, the stem makes splendid fires for house use and when burning (from its gummy nature) throws out brilliant jets of gas equal for some time after ignition to the "Electric Light". The trunk of the Xanthorrhœa or grass tree is also frequently employed in making roads over boggy ground, by placing them side by side and covering moderately with granite or gravel; some of the roads thus made are still in good order having been in use for a period of 40 years. The grass tree has an existence of from 4 to 500 years. The rush forms the head of the tree, the heart from which the rushes shoot is perfectly white and when struck out by an axe falls by a spring to the ground, weighs 4 or 5 ounces and is a delicious vegetable, equal to asparagus. The heart and also the seed cone contains a large quantity of sugar, and is the food of cattle, horses, and other stock.

Many millions of tons exist in West Australia. There are 4 if not 5 varieties well known to that scientific Botanist, Baron Von Mueller, the known benefactor and disseminator of useful information to his fellow men, and whose botanical researches have been of great service to the Medical profession.

Liquid gums exude or flow from the Red Gums of the Colony North and South. It is collected by tapping trees of all sizes, placing tubs under the outflow, which lasts for varied periods of time. This gum is worth from £20 to £25 per ton, and is used for tanning purposes. It is also said to be an excellent dye.

CHARCOAL may be found all ready for use over all portions of the Colony. Jarrah charcoal is the best, throwing out an immense and powerful heat, and is generally used. Men employed in burning charcoal make as much as £3 per week.

Plantations.

At present plantations of our Colonial Timber are not required, the forests of the Darling Range discharge a constant supply of seed annually, which germinate soon after the commencement of winter. Vast quantities of the young plants perish from the sweeping destruction of bush fires and drought, but sufficient plants are left to form a future supply of timber for the next generation; added to this trees or plants removed from such soils, as a rule, perish. The young plants for a few years grow with much rapidity (according to the nature of the soil), but when the stem rises to the height of about 20ft., it begins then to gain bulk, and its increase in growth is perceptible from year to year.

Plantations of our hard wood timbers are not required, but our soil and climate are well adapted to the growth of many foreign timbers, and if large quantities of seeds of soft woods from the forests of Tasmania and New Zealand were planted, in a very few years they would form the nucleus of a trade in soft woods, as these woods grow well in the Colony. The Pine, after 40 years, or even less, would be available for trade in Western Australian climate. In the first instance it would be the duty of Inspectors, or men appointed for the purpose, to fix on localities suited to the growth of these plants, such as ravines, along the banks of rivers or streams, on land suitable for or containing ferns, on lands recently burned by bush fires, or on spots on which the ashes of burned trees are plentiful. A large supply of Pine seeds would be required, according to the supply. The value of these trees would be of great benefit to the Colony in a few years, for the rapid growth of the Pine in Western Australia is astonishing, and such plantations would be of greater value from the fact that we have no soft woods in the Colony, while in an ornamental point they would form a pleasing addition to the scenery of Western Australia.

Conservation—Steps to be adopted for prevention from fire.

The conservation of our forests (those portions leased to companies in the Sister Colonies) is a rather difficult matter, at least until an Act is passed for their better protection. In the meantime, however, an officer should be appointed, whose duties would be to visit all the timber stations, North and South, and to make himself acquainted with the range of Jarrah or other timber in the neighborhood of the mills, to seek every information from the managers of the several stations, generally well disposed, and to suggest to them the necessity of economising the timber, when supported by the laws in this Colony. The waste of our timber is at present enormous. No doubt the Government can make any infringement of their wishes in respect to conserving our timber and preventing the present enormous waste, very unpleasant to the owners of these mills, for with a moderate expenditure it could be done at a profit to the companies, instead of as at present a loss. I now can see no means or system employed, no method adopted or followed to prevent this waste; nothing but fire is used for the wholesale destruction of our best timber.

As a rule, the settlers cutting timber for fencing purposes or farm use are most economical and cautious, while at the stations an immense quantity of valuable timber is burned, such as slabs, or the outside cuttings; these might at a profit be cut into pales, shingles, rafters, posts for wire fencing, for furniture and for other uses. Waste timber may be easily protected, either by placing it in shallow pits, and covering with sand, or by putting in dead water (salt or fresh), the latter a splendid preservative. Relative to timber cut by fallers in the bush, an Inspector ought to examine localities on which men are employed, *i.e.*, during four months in the year, December, January, February, and March, to inspect trees cut down and left to be destroyed by fire. Such examination could be made with little difficulty; added to this the number of tracks made by timber carriages will prevent much damage.

Steps to be Adopted for Prevention of Fire.—There would be practically no great difficulty in stopping bush-fires, but no great advantage would accrue from the attempt—sooner or later fires will come, and the advantages gained by bush fires more than counterbalance the disadvantages. In fact bush conflagrations are frequently advisable. Leave the forests unburnt for a few years, allow the shrubs to flourish, fallen trees to thicken on the ground, with dead leaves, impregnated with turpentine, to accumulate and the destruction of the aged Jarrah, the young plants, and seeds will be completed. Allow the fires as a rule to take their course—if possible every 2 or 3 years. If you wish to preserve timber from an overgrown scrub burn the country in lanes, or on each side of a water-course; fires help to split the seed pods and make them more susceptible to the early rains.

Fires South and West of Busselton travel at the rate of 3 miles per day, even not so fast. No doubt fires in the Northern ranges require greater caution and more stringent measures might with advantage be adopted, as in the North the climate is not so moist or the under-growth so green as to the South.

The boundaries of the Northern and Southern ranges may be fixed on the Preston River.

Propositions and Remarks.—The qualities of the Jarrah and Karri are very similar. The Jarrah is grown on the ironstone ranges upheaved during past ages, and containing an acrid poison "Copperas." The Karri grows on an unconglomerate bed-clay not yet upheaved or cemented with rock, but containing the same acrid poison; when sawn up it has the same color as the Jarrah; it would therefore be advisable to brand the timbers with a separate brand.

Instruments or Acids for the destruction of the Teredo.—The Teredo occasionally attacks the Jarrah, especially piles. It appears perfectly feasible, practicable, and intelligible to invent a flexible, pliable, probe or needle of steel to follow up the Teredo to the scene of its operations, generally in a straight line, or to inject an acid which would kill it; some such remedy would be of great service in saving timber slightly attacked.

Timber immersed in salt water should be cleaned and scraped with great care from seaweed and other matter affording protection to the Teredo.

Measures should be adopted to stay native fires on the timber ranges, particularly northwards from Bunbury. Heavy fines inflicted on persons leaving fires burning at their camps, firing the country, except at certain seasons and in certain localities, might tend to reduce the destruction of timber in this way. Permits might be granted, in the months of April and May, to burn strips of scrub between the belts of trees to improve the feed for stock and lessen danger from fire. At the South the timber country might, with advantage, be burnt every four or five years.

Rewards may be given to parties giving information against those who without permit cause conflagration.

Useless fallen tops of trees and decayed logs upon licensed lands might be destroyed by burning at fixed seasons, but any restrictions upon contractors in this respect might not be advisable.

Seasoning Jarrah timber when cut with the sap rising requires more care than when down as it is much more liable to split, but there is little doubt it contains more copperas when the sap is up. And it may be useful to add that saw-dust from green timber cast into the water among fish will poison them in large quantities.

Geographe Bay and Railway to Warren and Donnelly.—No one will venture to dispute that Geographe Bay is the most central and safe port for the export of all the most valuable timbers.

From the coast the Tuart is the first belt of timber met with; secondly, the Red Gum; thirdly, the Jarrah and Blackbutt; lastly, Karri together with Jarrah in immense quantities and immense trees; in fact the finest of their species are to be found in the Blackwood and Warren Districts as far back as Lake Muir, 120 miles from Busselton.

At Busselton there is a useful jetty alongside of which vessels of 250 tons can be loaded all through the Summer and a greater part of the Winter months. The anchorage in Geographe Bay is such that no danger may be anticipated by well-found vessels.

The country as far as the Jarrah ranges is perfectly level, and no great difficulties would be met in passing a railway through into the Karri country beyond.

A line should follow the table lands on the Galbaragup road, East and West of which splendid timber is to be found no great distance from Busselton. This line would meet the Blackwood River some 35 miles from the coast, where an immense extent of the finest forest country is found. In extending the line with a view of reaching the Karri country through the most accessible parts of the country the line would follow the Blackwood in an easterly direction and cross at the Narrup Brook; following this to its source in a southerly direction some 8 or 10 miles when the table lands on the sources of the Donnelly and Warren Rivers would be met on to the Warren Bridge, then to Lake Muir. This route would embrace the best timber country in the Colony, an inexhaustible supply worth millions, and open up fine agricultural and pastoral lands.

Portable mills are found to be in every way best adapted in the production of timber, and it should be sent down the line for shipment in a marketable state.

As to markets for these timbers, we may look for a steadily increasing demand from the Australian Colonies, Ceylon, India, Isle of France, China, Natal, Cape of Good Hope, Java, Singapore, and the Northern districts of the Colony, and from which places at no distant date we may reasonably expect an enormous demand.

The climate of these southern forest ranges is healthy. Cattle do remarkably well, and agriculture in the exceedingly fertile valleys would have attention were the means of bringing the produce to the coast available.

EXTRACT FROM LAND REGULATIONS FOR THE COLONY OF WESTERN AUSTRALIA, PROCLAIMED ON THE 11TH OCTOBER, 1882.

Timber Regulations.

Timber Licenses.

110. Any person or a pair of sawyers, splitters, or cutters, requiring a license to fell, cut, split, and remove, either by himself or by an agent or servant authorised in writing by him, any timber, sandal, jam, fire, and other wood growing or being on Crown lands, may apply to the Commissioner of Crown Lands, to the Collector or to any Sub-Collector of Revenue, or to any Resident Magistrate, who shall thereupon issue the required license, after payment in advance of the fees in that behalf herein mentioned.

Fees chargeable for licenses to cut timber.

	Per month. £	s.	d.
To fell and hew timber to be used or exported as piles or balks, for each man	3	0	0
Or in the case of a pair being employed	5	0	0
Such license includes all men employed in removing timber in balk or for piles during the currency of the license.			
To fell, cut and remove timber, or split and remove fencing, firewood, or shingles, for each man	0	5	0
To cut sandalwood outside proclaimed areas, and wattle or other bark, for each man	0	2	6

No such license shall be issued for a period less than one nor more than twelve months. The names of the parties applying for a license shall be inserted therein, and no such license shall be transferable; but all timber marked, branded, or otherwise described by its licensed owner may remain on Crown land for a period not exceeding six months after the expiration of a license.

111. Persons engaged in cutting down trees in any shape, so long as the same are cut and removed simply and *bonâ fide* for the purpose of being split or sawn up, and not for use or shipment as piles or balks, will have to take out a license for such cutting down, for which they will have to pay five shillings per month for each person engaged; and every person engaged in the removal of such timber will have to take out a similar license before he can assist in its removal.

Persons holding a five shilling license may cut down a tree and remove it as a log or balk to their saw pit; and persons having saw mills at a distance from the place where the trees are to be found, may, on taking out a five shilling license for every person engaged in cutting down or removing such trees, lawfully cut down and remove them in balk or as logs to their saw mills, so long as they do this solely for the purpose of splitting or sawing them up, and not for the purpose of using or exporting them as piles or balks.

Stacking of debris.

Penalty on default.

112. It shall be obligatory on all persons cutting jam or other small timbers for fencing or for firewood, to stack up in heaps, and at distances of not less than one chain apart, all branches and other debris left by them. Any breach of this Regulation shall render the offender liable on summary conviction to a penalty not exceeding ten pounds, and to forfeiture of his license.

Special license for the year.

113. Applications for special licenses for one year to fell, remove, and sell the timber growing or being on any particular Crown lands may be addressed to the Commissioner of Crown Lands by letter, fully describing the quantity, position and boundaries of the land required, and the date from which a license is to commence. Any such application shall be accompanied by a deposit of five pounds, or by the receipt of any Collector of Revenue for that amount. The land applied for shall be selected and described according to the rules laid down in Nos. 47-50 of these Regulations. *

Preparation of special licenses.

114. Special licenses shall be prepared in the Office of the Commissioner of Crown Lands, in the form in Schedule No. 17, and shall be deliverable by any Collector of Revenue, or by the Resident Magistrate of the District in which the land may be situate, on payment of any balance due thereon, according to the following scale:—

	Per annum. £	s.	d.
For any quantity not exceeding 640 acres of land ...	20	0	0
For any quantity exceeding 640 but not exceeding 1,280 acres of land	40	0	0

But such license shall not permit the cutting, hewing, and removing of logs and piles.

Duration.

115. Every such license shall be for one year; and if not taken up at Albany within two calendar months, or at Perth and other districts within one calendar month from the date of deposit, the license shall be forfeited, together with the deposit, and the land shall be open to fresh applicants. The license shall not be transferable.

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* 47. Every section of rural land shall be in one block, and, if possible, a right-angled parallelogram. The proportion of breadth to depth in any section bounded by a frontage line shall be as one to three, unless by approval of the Commissioner of Crown Lands in special cases.

48. A frontage line shall be taken to mean the boundary of a road, river, public reserve, or any sea-coast, permanent stream, or lake.

49. When, from the frontage not being a straight line, or from the interference of other frontage lines, natural features, or the boundaries of private lands, the foregoing rules in respect of form cannot be accurately observed, the form of the section shall be determined as nearly in accordance therewith as circumstances permit.

50. Every application for the purchase of rural land in fee simple, if made before the land has been permanently surveyed by the Crown, shall be accompanied by a sketch of the proposed boundaries, which shall be fixed wherever possible with reference to some natural or permanent artificial object, and also showing the position of the land with reference to any lake, river, or main stream, and also to land held by or in the occupation of any other person; and also showing all permanent water-holes and springs within its area. The form of application will be found in Schedule No. 4. Every application must be accompanied by a fee of two shillings and sixpence.

Rights conveyed.

116. No rights or privileges shall be conveyed by any such license beyond those of felling, cutting up, and removing by the licensee, his servants or agents, any indigenous timber growing or being on the land specified in the license; and at the expiration of the license all timber left on the ground shall be the property of the Government, unless otherwise arranged by special application in writing, addressed to the Colonial Secretary, or by a renewal of the license for a further term, to which an existing licensee shall be considered to have a preferable claim.

Special licenses for promoting public undertakings.

117. In order to promote the introduction and establishment of new industries and commercial undertakings of public utility, the Governor in Council may grant special licenses to cut and remove timber from Crown lands for such period as may be deemed necessary, and such licenses shall be subject to such rents, fees, conditions and reservations as the Governor in Council may prescribe, but shall not entitle the licensees to any right of renewal at the expiration of the term.

Validating timber licenses issued not in accordance with existing Regulations.

118. Any timber license already granted or agreed to be granted, for a longer period than twelve months with a right of renewal or otherwise, not in conformity with these Regulations, shall not on that account be deemed to be invalid, but may be held and renewed according and subject to the terms and stipulations on which the license was granted or agreed to be granted.

Timber, shrubs, &c.

119. The Governor in Council may from time to time, by order published in the *Government Gazette*, regulate the cutting and disposal of timber and other trees, shrubs and plants, whether for use in the Colony or for exportation, living or dead, being or growing on lands held otherwise than in fee simple.

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36 Vict., No. 8.—To prevent the Unauthorised Occupation of Waste Lands of the Crown.

Section 1.—Any and every person not holding a license, lease, or authority under the regulations for the sale, letting, disposal, and occupation of waste lands of the Crown, who, either by himself or by his servants, agents or workmen acting under his directions, shall be found in the unlawful and unauthorised use and occupation of any waste lands of the Crown, either by depasturing stock thereon, or by residing, or by erecting any hut or building thereon, or by clearing, enclosing, fencing, or cultivating the same or any part thereof, or by cutting, sawing, felling, splitting, or removing timber and other trees thereon being, or by doing or preparing to do or having done any act, matter or thing thereon, which in the opinion of the convicting Justice or Justices shall amount to an unlawful and unauthorised use and occupation thereof, he shall, on conviction, be liable to a penalty not exceeding One hundred pounds.

42 Vict., No. 4.—To amend "The Waste Lands Unlawful Occupation Act, 1872." 36 Vict., No. 8.

Section 2.—From and after the passing of this Act, any person who shall saw or split any wood on the waste lands of the Crown, or remove any wood from off the waste lands of the Crown, without lawful authority to do so, shall be deemed to be in the unlawful and unauthorised use and occupation of the waste lands of the Crown within the meaning of the said Act.

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THE FOREST RESOURCES

OF

WESTERN AUSTRALIA

REPORT

ON THE

FOREST RESOURCES

OF

WESTERN AUSTRALIA

BY

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REPORT

ON THE

FOREST RESOURCES OF WESTERN AUSTRALIA.

INTRODUCTORY REMARKS.

THE forest-regions of extra-tropic West Australia occupy an area equal to the whole territory of Great Britain; and it is singularly fortunate for the colony, that over this vast extent of wooded country a species of Eucalyptus (the Yarrah) prevails which for the durability of its timber is unsurpassed by any kind of tree in any portion of the globe. Under such circumstances the timber resources must be regarded as among the foremost in importance throughout the wide tracts of West Australia, even if the many other kinds of utilitarian trees, occurring in the more southern portion of that colonial territory, and the still more varied sorts of timber-trees, to be found within the intra-tropic regions of West Australia, were left out of consideration.

It is furthermore of particular advantage to the colony that its highly valuable Yarrah-timber is obtainable through at least five degrees of geographic latitude, and this within so short or moderate a distance of shipping places as to render it easily accessible to foreign traffic.

But as nowhere, not even in the most extensive woodlands, can the supply of timber from natural forests be considered inexhaustible, a rational far-seeing provision for the maintenance (if not for the enrichment) of its forest-treasures is needful for West Australia, however indiminishable these may appear to be at present.

In all densely-populated countries the consumption of timber is out of all proportion to the natural upgrowth or even cultural renewal of indigenous forests; and this disproportion of want to local supply will become greater and greater in the course of time, when denser settlements will be formed in those countries, from whence now subsidiary or main timber supplies are obtained. Hence also the celebrated Yarrah-timber will become still more highly appreciated by subsequent generations; and as its replacement in cleared forests cannot be effected with the same celerity as that of several other less valuable timber producing Eucalypts, we may assume that any Yarrah-forest, if allowed to go to destruction, would probably not be replaced more quickly than those of many European or North-American trees, still largely (but not likely for ever) yielding timber for export, even if agricultural and pastoral pursuits, with their ever-increasing demands for ground, would not likewise diminish the natural areas of the Yarrah-Eucalypt in West Australia. Moreover, the forest questions have their particularly important bearings, inasmuch as the West Australian territory, stretching through such wide geographic parallels, can rear in reality *any* kinds of timber of the globe by cultural processes, the trees of colder countries being adapted to the cool and humid climate of the most south-western portion, whereas trees of the tropic zone would prosper along the north-west coast. This is not without significance, when we reflect, that neither the North-American, nor the Baltic, nor any other northern countries will continue to furnish the indispensable deal for indefinite periods to other parts of the globe, where pine-woods do not exist either naturally or copiously; in the same manner, every tropical country (and this applies also largely to West Australia) should strive to transfer the leading timber-trees of the hot zone to its own shores for independent supplies, more especially as tropical species, unlike many from the colder zones, are seldom gregarious anywhere. Considerations of forest-resources are therefore of particularly weighty meaning to West Australia under manifold aspects.

For clearness' sake it is deemed desirable to treat in this succinct report the forest question of West Australia in four divisions :—

1. To elucidate phytographically the various native timber-trees, hitherto leadingly there in use, by descriptive notes and lithographic illustrations for easy and accurate specific recognition, and to add some brief data on their respective utilitarian importance.

2. To explain the chemic and microscopic characteristics, indicative of various qualities of Eucalyptus-wood.

3. To show by what cultural and industrial measures the yields and riches of the West Australian forests could be largely enhanced.

4. To express my views, how in a young colony with a very sparse population, an inexpensive forest administration could be effectually initiated.

A brief document, like the one intended for this occasion, cannot be expected to treat exhaustively the forest-interests of a country as large as European Russia, and with a clime far more genial, more particularly as the writer had only on three occasions the opportunity of traversing portions of the vast extent of West Australia, and then only for a few weeks each time—in 1856 (as naturalist of the expedition sent out by the Duke of Newcastle, under Aug. Gregory), some of the north-eastern regions along Sturt's river from latitude 18° to 22° 20′ south; in 1867, the Stirling range and surrounding country, and the vicinity of King George's Sound; and in 1877, the country from Champion Bay to Shark Bay, and also from Swan River to Geograph Bay, and thence to the Shannon and Gordon rivers—these last-mentioned journeys being carried out under special facilities, liberally afforded by the West Australian Government.

I.—SPONTANEOUS FOREST RESOURCES OF WEST AUSTRALIA.

A.—*Eucalyptus Timber.*

From the extra-tropic territory of West Australia, as far as phytographically explored, about half a hundred species of Eucalypts have hitherto been made known; while we are acquainted with about thirty tropical species, which extend into the West Australian territory. A portion, however, of these eighty Eucalypts form only small trees, or are of shrubby growth. The technic value of many even of the arboreous species, particularly those of inland districts, and those of the intra-tropic latitudes, have been up to this time almost completely unascertained for the purposes of artisans. In the following pages, therefore, only those kinds are alluded to of which the timber has come into general use, and has been tested by lengthened experience; but it may be assumed that many of the other Eucalypts of the West Australian dominions can be brought advantageously into industrial use; and inasmuch as the north-west coast possesses several excellent harbours, the shipment of many new kinds of serviceable Eucalyptus-timber for export is likely to take place in years to come, when also that ample territory will become more densely settled by colonists. It may here be observed that, fas ar as known, Eucalypts form also in the intra-tropic portions of West Australia the prevailing timber, although they are in many places largely interspersed there with trees of Indian types.

It must be patent to every contemplating mind that a most accurate knowledge of the characteristics of each species of tree is imperatively necessary to discriminate between allied kinds, the timber of which, notwithstanding close specific affinity of the trees themselves, is often found to be widely different in its adaptability to particular work, or in its resistance to the ravages of insects or other destructive creatures, whether of animal or (as fungi) vegetable growth. Besides, an intimate knowledge of each particular species will also render any culture of them easier, in choosing for each the clime and soil respectively best adapted for them. Hence descriptive details and lithographic illustrations are now offered, to render the recognition of at least the leading South-West Australian species safe and altogether free from difficulty.

1. *Eucalyptus marginata.* Smith, in the Transactions of the Linnean Society of London, vi. 302 (1802). Bentham's Flora Australiensis, iii. 209. The Yarrah-tree, or West Australian Mahogany-Eucalypt.

Leaves scattered, on moderately long stalks, from oval to narrow-lanceolar, somewhat curved, acuminate, paler and not shining underneath, with numerous very spreading veins, the intra-marginal vein at some slight distance from the edge; flower-stalks almost all axillary, with three to twelve flowers, slender and usually compressed; the stalklets (of each individual flower) longer than the tube of the calyx; lid from semi-elliptical to narrow conical, about twice as long as the tube; stamens all perfect, flexuose, but not bent back before expansion; anthers heart- or kidney-shaped, opening by longitudinal slits; fruit ovate-globular, truncate, the margin of the summit flat; valves three, enclosed or but slightly exserted; seeds without membranous appendage.

The Yarrah-tree extends over the greater portion of the country from the Moore river to King George's Sound, advancing also to Cape Leeuwin, forming mainly the forests of these tracts. Isolated patches of straggling trees occur in some places beyond the main area here indicated. It does not enter to any extent the forests of Karri and York Gum-trees. The tree exceeds occasionally 100 feet, but rarely 150 feet in height. On account of its persistent and somewhat fibrous bark, it would be classed with the "stringy bark trees" of the eastern colonies, had it been an inmate of the forests there. Hence in the cortical system it must be inserted among the Pachyphloiae. The wood has attained a world-wide celebrity; when especially selected from hilly localities, cut while the sap is least active, and subsequently carefully dried, it proves impervious to the borings of the Chelura, Teredo, and Termites; it is therefore in extensive demand for jetties, piles, railway-sleepers, fence-posts, and all kinds of underground structures, and it is equally important as one of the most durable for the planking and frames of ships. It is also much used locally for flooring, rafters, spars, and furniture; though hard (particularly that of the ironstone ranges) it is easier worked than wood of E. loxophleba and E. redunca. The timber from hills is darker, tougher, and heavier than that from plains. The weight of well-seasoned wood is, at an average, about sixty-four pounds for the cubic foot. It is one of the least inflammable for building structures, and one of the very best in West Australia for charcoal, not burning so readily into ashes as most kinds of Eucalyptus-wood. Stems have been measured eighty feet to the first branch, with a circumference of thirty-two feet at five feet from the ground. For shingles the wood is doubly as durable as even that of Casuarina Fraseriana, though it is more apt somewhat to warp, if not well selected.

In explaining in this and all other cases the uses of any particular Eucalypt, it must be understood that it is not attempted in these pages to sum up all the purposes for which any particular species of timber can be employed. This cannot fully and satisfactorily be done from such inquiries as, amidst multifarious engagements and observations, the writer could carry out during the short periods of his travels in West Australia, but must be left to the circumspectness of local artisans, whose accumulated experiences during the fifty years' existence of the colony must have become both extensive and reliable. This much, however, can be foreseen, that E. marginata is destined to supply one of the most lasting of hardwood timbers for a long time to come, at the least costly rate, to very many parts of the globe.

The specific name adopted by Sir James Smith for Eucalyptus marginata is not very expressive, as it relates merely to the somewhat thickened margin of the leaves, which indeed is not more evident than in most Eucalypts. The founder of the Linnean Society received his specimens from Archibald Menzies, naturalist to the expedition of Captain Vancouver, who in 1791 discovered and named King George's Sound, and who was thus also instrumental in rendering known first of all many South-West Australian plants.

Explanation of Lithogram. Plate I.

The main Lithogram (Plate I.) exhibits in this, and all subsequent Plates, the natural size of the foliage, flowers, and fruits.

1. Longitudinal section of unexpanded flower; 2. Front view of anther (with portion of the filament); 3. Back view of the same; 4. Style, with its minute stigma; 5. Longitudinal section of fruit; 6. Transverse section of fruit; 7. Sterile seeds; 8. Fertile seeds; 9. Embryo.—1 to 4 and 9, magnified; 5 to 8, natural size.

2. *Eucalyptus calophylla.* R. Brown, in the Journal of the Royal Geographical Society, 1831, 20. Bentham's Flora Australiensis, iii. 255. The Red Gum-tree of South-West Australia (but not of the interior or the eastern colonies).

Leaves scattered, on long stalks, broad- or lanceolar-ovate, acute, of rather thick consistence, much paler and not shining underneath, with numerous very spreading subtile closely-parallel veins, the peripheric vein contiguous with the margin; umbels four- to six-flowered, interminal panicles, or some few axillary and solitary; stalklets quadrangular, generally about as long as the stalks and as the pear-shaped calyx; lid depressed-hemispheric, very short, only about half as broad as the tube of the calyx; stamens all perfect; filaments inflexed before expansion; anthers cuneate- or oval-oblong, with parallel cells opening lengthwise; fruits large, urceolar-ovate, three- to four-celled, not angular; valves short, deeply enclosed; fertile seeds very large, brown-black, at the edge acute, but not produced into a membranous appendage.

Interspersed with the Yarrah-Eucalypt throughout nearly the whole area of that species, but less gregarious, though next to it the most frequent of South-West Australian trees, seemingly reaching its northern boundary on the Hill river and its southern at King George's Sound, mixed also into the forests of E. loxophleba, but not into those of E. diversicolor.

The most umbrageous among tall Eucalypts of the colony, on account of its leaves turning the surface more than the edge to the zenith, a characteristic which it shares with but few Eucalypts although with most other trees of the globe. The bark is persistent, rough, furrowed, and pervaded with Kino, for which reason this species would be ranked with the Ironbark-trees of Eastern Australia, if indigenous there. Its place in the cortical system is among the Schizophloiae. The foliage of younger seedlings is remarkable, their stems, leaf-stalks, and leaves being beset with bristly hairs, while the leaves are affixed, not like leaves of the more aged tree to their stalks at the base, but are inserted at a considerable distance above the base, as shown in the background of the lithographic illustration.

The growth of E. calophylla is far more rapid than that of E. marginata. The tree yields locally much timber for naves, harrows, ploughs, shafts, spokes, rafters, handles, frames, rails, and various building operations; but the wood cannot be utilised for underground work, being subject to decay when so placed. It is generally more free of Kino-substance when grown on alluvial soil, and is tougher than that of E. marginata, but not so strong as that of E. loxophleba; this is the only tree in West Australia producing Kino copiously, this tanning substance being drawn into use not only locally as an admixture to the bark of Acacia saligna, but exported also both in a liquid and a dry state. In height E. calophylla is not inferior to E. marginata, and stems have exceptionally been observed with a diameter of ten feet.

Robert Brown, when as companion of Captain Flinders in 1802 he visited the south coast of

West Australia, bestowed the specific name on this tree seemingly for a double reason, because the foliage is far more beautiful than that of most Eucalypts, and also because the venation of the leaves reminds of that of the tropical genus Calophyllum of Linné.

Explanation of Lithogram. Plate II.

1. Longitudinal section of unexpanded flower; 2. Front view of a stamen; 3. Back view of a stamen; 4. Style with stigma; 5. Transverse section of fruit; 6. Longitudinal section of fruit; 7. Sterile seeds; 8. Fertile seeds; 9. Embryo.—1 to 4, magnified; 5 to 9, natural size.

3. *Eucalyptus ficifolia.* F. v. Mueller, Fragmenta Phytographiae Australiae, ii. 85 (1860.) Bentham's Flora Australiensis, iii. 256. The crimson-flowered Eucalypt.

The characteristics of this species are so similar to those of E. calophylla, that it is deemed unnecessary to offer a diagnosis. The diversity of E. ficifolia rests on the following points:—The tree is of smaller stature, the greatest height not exceeding fifty feet; the bark is generally still more deeply furrowed; the leaves are usually longer, more acuminate and less dotted; the calyces are on the whole rather larger, somewhat tinged with red, longer in proportion to their width; the filaments are of a magnificent crimson; the seeds are of a pale colour and provided with a membranous appendage. To this may be added, that the seedling at no time of its growth is conspicuously rough from bristlets, nor do the leaves even in the earliest period of the plant show the insertion to be supra-basal to the stalk.

The geographic distribution of this species is very limited; it extends, according to Messrs. Muir and Maxwell, from the western side of Irwin's Inlet to the mouth of the Shannon, the forests of this tree forming a belt not quite near to the coast nor very remote from it, the furthest distance inland being about eight miles. Hardly anything more gorgeous can be imagined than the forest of E. ficifolia about the month of February, when the brilliant trusses of flowers diffuse a rich red over the dark-green foliage of the whole landscape.

Although of the value of the timber nothing as yet is known, this species could not be passed in this report, it being even almost unknown to West Australian colonists, though its floral magnificence was demonstrated already in 1867 from trees reared by the writer in the Botanic Garden of Melbourne. More recently it has been introduced into the countries around the Mediterranean Sea, and into several other parts of the globe free of frost. A lucrative trade in seeds of E. ficifolia is sure to arise, as through my exertions this species, like many other West Australian plants, has now become widely appreciated.

The tree ought also in West Australia to be reared as an umbrageous, highly ornamental avenue-tree.

The species was first described from a mere fruiting branchlet, and received its name from the resemblance of its foliage to the leaves of several species of Ficus, of the series to which the Indiarubber Fig-tree belongs.

Only two other tall Eucalyptus-trees can perhaps be compared in floral splendour to the present species—namely, E. miniata (A. Cunningham, in A. Walpers's Repertorium, ii. 925, anno 1843), and E. phoenicea (F. v. M., in the Journal of the Linnean Society, iii. 91, anno 1859), both extending from Carpentaria into the most northern regions of the West Australian territory, the colour of their flowers being a fiery orange.

Explanation of Lithogram. Plate III.

1. Longitudinal section of unexpanded flower; 2. Front view of a stamen; 3. Back view of a stamen; 4. Pollen grains; 5. Style; 6. Longitudinal section of fruit; 7. Transverse section of fruit; 8. Sterile seeds; 9. Fertile seeds; 10. Embryo *in situ;* 11. Embryo unfolded.—All magnified. At the upper right-hand corner of the lithogram is shown the branch and leaves of a seedling plant.

4. ***Eucalyptus diversicolor.*** F. v. Mueller, Fragmenta Phytographiae Australiae, iii. 131 (1863). Bentham's Flora Australiensis, iii. 251. The Karri-tree.

Leaves scattered, oval-lanceolate, somewhat sickle-shaped, paler beneath, traversed by numerous very spreading and subtile veins, the intra-marginal vein somewhat distant from the edge; umbels axillary, solitary, three- to six-flowered, on almost cylindric stalks; calyces ellipsoid, with attenuated base on stalklets hardly as long; tube not angular, nearly twice as long as the lid; stamens inflexed before expansion; anthers almost heart-shaped, opening with longitudinal slits; fruit truncate-ovate, three-celled; valves enclosed; seeds small, without any membranous appendage.

In the humid country at and near the Warren, Shannon, Donelly, Walpole, and Gardner rivers, towards the coast constituting forests, occurring also as far east as Mount Manypeak and the Porongerup, and westward fully to Cape Leeuwin. This gigantic tree has only one single rival on our island-continent, the Eucalyptus amygdalina (var. regnans) of South-East Australia, the grand features of which it completely repeats. Startling accounts of monster specimen trees are on record, and its maximum height is certainly not over-estimated at 400 feet. Messrs. Muir measured stems 300 feet long up to the first limb. When closely growing the young trees have a very slender stem, so much so, that a tree 180 feet high, and with comparatively but little foliage, may have a stem not over one foot in diameter. Captain Pemberton Walcott found the circumference of one particularly gigantic tree to be 60 feet around the base.

Although we do not know what giants the forests of Central Africa, many unexplored parts of continental and insular India, New Guinea, and also perhaps South America may still present, yet so far as known to West Australia and Victoria must at present be awarded the palm for the tallest trees in the world, the only ones which so far can be brought into comparison with them being the Wellingtonia-pine and Sequoia-pine of western North America, unless perhaps Pinus grandis, Pinus Menziesii, Pinus Lambertiana, and Pinus Douglasii, also enter into competition as regards enormous height.

Widths of timber of as much as twelve feet can be obtained. The whitish smooth bark of the huge stems of mast-like straightness impresses a peculiar feature on the Karri-forests, and places this species into the Leiophloiae of the cortical system. These particular woodlands not being very accessible our experience of the value of the timber is still imperfect, but the Karri-timber will become doubtless important for the lumber trade, whenever the harbours between King George's Sound and Cape Leeuwin shall have been fully opened up for commerce and settlement. The wood is regarded as elastic and durable, but it is not so easily wrought as that of E. marginata; it has proved valuable for shafts, spokes, felloes, and rails, and is particularly sought for large planks. The writer has introduced the tree into Victoria, also into South Europe and North Africa, and to some extent elsewhere, it being easily manageable in culture and of comparatively quick growth. Abroad this species, on account of its huge dimensions, passes very often as Eucalyptus colossea; but the name here adopted according to the laws of priority cannot be changed now; it arose at a time when the colossal height of E. diversicolor was quite unknown. The specific name was derived from the paleness of the leaves on the lower side, unusual among allied species.

Explanation of Lithogram. Plate IV.

1. Two forms of the unexpanded calyx; 2. Longitudinal section of unexpanded flower; 3. Front view of stamen; 4. Back view of stamen; 5. Pollen grains magnified 300 times diametrically; 6. Pistil; 7. Fruit seen from above; 8. Abnormal form of fruit; 9. Longitudinal section of fruit; 10. Transverse section of fruit; 11. Sterile seeds; 12. Fertile seeds; 13. Embryo; 14. The same expanded.—The comparison with the principal drawing, which is of natural size, will indicate the degree of enlargement of the analytic figures.

5. *Eucalyptus loxophleba.* Bentham, Flora Australiensis, iii. 252 (1866). The York Gum-tree.

Leaves scattered, curved-lanceolar, acuminate, equally green on both sides, their veins somewhat distant and prominent, the peripheric vein distinctly removed from the margin; umbels axillary, solitary, six- to twelve-flowered, on cylindric or faintly compressed stalks; tube of the calyx obconic, not angular, attenuated into a short stalklet; lid hemispheric or pyramidal-conical, shorter than the tube of the calyx; stamens short, inflexed before expansion; anthers minute, opening with longitudinal slits; fruit truncate-ovate, three to four-celled, its rim narrow; the valves deeply enclosed; seeds small, without any appendage.

On the eastern tracts of the Darling ranges a main constituent of the forests, extending only through a narrow strip of country eastward beyond them, spreading northward in a variety called by the natives Yandee, to the Murchison river, and, according to Mr. J. Forrest, eastward as far as Kojenup, and thence southward to near King George's Sound.

This tree occupies more particularly the eastern slopes of the Darling range, not entering the western tracts where the Yarrah-Eucalyptus forms the main forest. It is content with poor soil. Its abundance near the town of York suggested the English name.

Never a very high tree, seldom exceeding eighty feet, not rarely of crooked growth; stem rarely above four feet in diameter. The bark is persistent and rough, and draws this species into the Rhytiphloiae; inside it is red like that of the Morrel-Eucalypt. The wood is regarded as the very best in West Australia for naves and felloes, on account of its toughness; though not sufficiently fissile to be split into rails, it is for this very reason preferentially sought for many superior purposes by artisans.

Mr. Bentham derived the name of this species from the direction of the veins of the leaves.

Explanation of Lithogram. Plate V.

1. Longitudinal section of unexpanded flower; 2. Front view of a stamen; 3. Back view of a stamen; 4. Style and stigma; 5. Longitudinal section of fruit; 6. Transverse section of fruit; 7. Sterile seeds; 8. Fertile seeds; 9. Embryo; 10. Cotyledons stretched out to exhibit their form and that of the radicle.—All magnified.

6. *Eucalyptus redunca.* Schauer, in Lehmann's Plantae Pressianae, i. 127 (1844). Bentham's Flora Australiensis, iii. 253. The Wandoo-tree.

Leaves scattered, ovate- or falcate-lanceolar, acuminate, their veins subtile and rather remote, the peripheric vein distant from the margin; umbels six- to twelve-flowered, on an usually compressed stalk; tube of the calyx narrow, attenuated into a short stalklet, twice or thrice shorter than the conical-pointed lid; stamens before expansion inflexed; anthers oblong, opening by longitudinal slits; fruit three- to four-celled, ovate or more oblong, truncate, but usually contracted at the summit; the rim narrow; valves enclosed or only their apex exserted; fertile seeds small without appendage.

Prevailing as a forest-tree on the eastern slopes of the Darling ranges, extending more sparingly northward to the Murchison river, and south-eastward to Cape Riche, as far as hitherto recorded.

It is a smooth-barked tree and the principal White Gum-tree of West Australia, so called on account of the hue of its bark, which on friction imparts a white colour, and is not shining.

The height of the tree only exceptionally exceeds 120 feet, and like several other Eucalyptus-trees it flowers often already in a shrubby state, when only a few feet high. The stem is known to have attained occasionally a diameter of seventeen feet.

In the cortical system it belongs to the Leiophloiae.

The wood is very pale, hard, and durable; it is much used for cart-shafts, spokes, cogs, rollers, naves, and felloes; indeed, for these purposes it is on the whole regarded as the best in West

Australia, although on account of its toughness it is difficult to work. The seasoned wood is so heavy as to attain a weight of seventy pounds to the cubic foot.

The tree is so indifferent in regard to soil as to prosper even on cold clayey or poor gravelly flats, where humidity stagnates in the wet season.

Dr. Schauer, of Breslau, who obtained specimens from Preiss's collection, chose the name of the species (not very aptly) from the curvature of the lid.

Explanation of Lithogram. Plate VI.

1. Calyces of two varieties, natural size; 2. Longitudinal section of bud; 3. Front view of a stamen; 4. Back view of a stamen; 5. Style with stigma; 6. Longitudinal section of fruit; 7. Transverse section of fruit; 8. Sterile seeds; 9. Fertile seeds; 10. Embryo; 11. Cotyledons moved from the radicle.—2 to 11, magnified.

7. *Eucalyptus cornuta.* Labillardière, Relation du Voyage à la Recherche de La Pérouse, i. 403, t. 20 (1799). Bentham's Flora Australiensis, iii. 234. The Yate-tree.

Leaves scattered, oblong-ovate or falcate-lanceolar, equally green on both sides; their veins thin, spreading, the peripheric vein somewhat remote from the margin; flowers from three to twenty-one, crowded on long solitary axillary cylindric or somewhat compressed stalks; lid horn-like, several times longer than the obconic bell-shaped tube of the calyx; stamens straight before expansion; filaments as well as the style yellow, very long; anthers comparatively long, narrow-ellipsoid, opening with longitudinal slits; fruit three- to four-celled; valves elongated, exserted, pyramidally connivent, cohering far up and passing into the style; fertile as well as sterile seeds without any appendage.

From the vicinity of Geograph Bay, at least as far as Cape Riche, the "Yate" is of rapid growth. In Lucknow, according to Dr. Bonavia (to whom I supplied the seeds), it attained in the first year eight to ten feet, and the young plants did not suffer there from the tropical rains, as is the case with so many other Eucalypts. I witnessed the quickness of its growth also at Melbourne, on even poor ground. The tree advances in age to a very considerable height. The bark of at least part of the stem is smooth and pale, hence the Yate must be placed among the Lerophloiae, unless it is preferred to arrange it with the Hemiphloiae. Its elastic and very hard wood is splendid for agricultural implements, boat-ribs, and is for wheelwrights' work as good as that of Eucalyptus loxophleba, while for cart-shafts it is regarded as equal to the best English ash-wood.

Mr. Muir noted a variety of Yate, which has the mass of its foliage flat-topped; besides this there is another variety, considered by some as a distinct species, the Eucalyptus Lehmanni (Preiss in Lehmann's Plantae Preissianae, i. 127), which mainly differs in having the calyces of the flowers and fruits connate into one mass.

Monsieur Labillardière discovered Eucalyptus cornuta in 1792 at Cape Leeuwin, when naturalist of the expedition sent out under the command of Admiral D'Entrecasteaux, in search of the missing ships of the unfortunate Count La Pérouse. The specific name was aptly given in allusion to the horn-like lid of the flowers.

Explanation of Lithogram. Plate VII.

1. Longitudinal section of unexpanded flower; 2. Summit of longitudinal section of unexpanded flower of a larger variety; 3. Front view of the upper part of a stamen; 4. Back view of the same; 5. Pistil; 6. Longitudinal section of fruit; 7. Transverse section of fruit; 8. Sterile seeds; 9. Fertile seeds; 10. Embryo.—1, 6, and 7, natural size; 2 to 5 and 8 to 10, magnified.

8. *Eucalyptus gomphocephala.* De Candolle, Prodromus Systematis Naturalis Regni Vegetabilis, iii. 220 (1828). Bentham's Flora Australiensis, iii. 231. The Tuart-tree.

Leaves scattered, on rather long stalks, sickleshaped-lanceolar, equally green on both sides, traversed by very fine and spreading veins, the longitudinal vein on each side very close to the margin; umbels axillary, solitary; three- to six-flowered; stalks broad, much compressed; stalklets none or extremely short; lid hemispheric or semiovate, hard, very considerably broader than the width of the obconic or somewhat urceolar tube of the calyx; stamens inflexed before expansion; anthers oblong-oval, bursting by longitudinal slits; style very short; fruit almost bell-shaped, rather large, somewhat angular, four-celled, their rims convex and broad; valves exserted; seeds without appendage.

In the calcareous coast-tracts at intervals from the vicinity of Swan River to near Cape Leeuwin. Never a tall tree, rarely attaining a height of over 100 feet, but the stem often of considerable diameter. Bark persistent, wrinkled, which thus designates this species as belonging to the Rhytiphloiae. Wood in use for shafts, naves, felloes, and various implements; it is solid, hard, and does not rend; it has come into use for shipbuilders' purposes and various artisans' work.

The specific name arose from the extreme turgidity of the lid, as compared to the width of the tube of the calyx. This characteristic renders this species one of the most easy for recognition.

Explanation of Lithogram. Plate VIII.

1. Longitudinal section of unexpanded flower; 2. Front view of anther; 3. Back view of anther; 4. Pistil; 5. Longitudinal section of fruit; 6. Transverse section of fruit; 7. Sterile seeds; 8. Fertile seeds; 9. Embryo; 10. The same unfolded to show the radicle fully.—All enlarged.

9. *Eucalyptus rostrata.* Schlechtendal, Linnaea xx. 655 (1847). Bentham's Flora Australiensis, iii. 240. The Flooded Gum-tree of the interior.

Leaves scattered, sickleshaped-lanceolar, of rather thin consistence, equally green on both sides; the veins fine, numerous, and pinnately spreading, the peripheric vein distinctly removed from the margin; umbels with from five to nine flowers, on a slender stalk; tube of the calyx semiglobular, much shorter than its thin stalklet; lid hemispheric towards the base, long, acutely and rather suddenly attenuated to its summit, or seldom gradually narrowed into a blunt apex; stamens inflexed before expansion; anthers roundish-ovate, opening with longitudinal slits; fruit small, towards the base almost semiglobular, its vertex protruding with the broad ascending margin; valves emersed, short; seeds without any appendage.

Generally lining the watercourses of the far interior, observed by me in the littoral portion of West Australia, southward only to the Murchison river, but occurring also in the oases, where humidity lodges, towards Shark Bay, thence often along the streams of also the tropical portion of West Australia.

This highly important tree indicates to explorers the lines of creeks, and to pastoral settlers, chiefly in the more central regions of Australia, the watering-places for their flocks. It is the famous "Red Gum-tree" of South Australia, Victoria, and the interior of New South Wales, but passes in Queensland as "Flooded Gum-tree." It is one of the few Eucalypts which stretch from the west-coast of the Australian continent to the east and north-east coasts, reaching also east of Great Bight the southern shores. This tree is seldom over 100 feet high; the bark is whitish, and remains smooth on account of the periodic secession of the outer layers, hence the species belongs to the Leiophloiae.

In the extraordinary endurance of its timber in underground structures, it has only one Australian rival—namely, the Yarrah—but surpasses that celebrated tree in ease and quickness of its growth. It can be reared even in often inundated places, which thus might be utilised for the production of one of the best timbers of the globe. It is also the leading species for forest-culture in tropical lowlands. For piles, culverts, telegraph-posts, railway-sleepers, and fence-posts no better timber can be chosen anywhere. For shipbuilding it is also in manifold ways available, as it resists, when well selected, the attacks of the crustaceous Chelura and Limnoria, and of the Teredo-mollusc, as well as of the Termites. The wood, moreover, is readily utilised for furniture and for endless building operations, much sought also for railway buffers, not to speak of minor artisans' works, for which it is eminently fitted.

The weight of a cubic foot of seasoned wood varies from fifty-three to fifty-eight pounds. The tree exudes also an excellent Kino for medicinal and tannic use.

Dr. von Schlechtendal, of Halle, gave the tree its specific name in allusion to the beak-like elongation of the lid of the calyx.

10. *Eucalyptus rudis.* Endlicher, in Baron von Huegel's Enumeratio Plantarum Novae Hollandiae Austro-Occidentalis, 49 (1837). Bentham's Flora Australiensis, iii. 244. One of the Flooded Gum-trees of the south-western coast-country.

Leaves scattered, from broad- to narrow-lanceolar, curved, copiously dotted with pellucid oil-glands, but not shining; the veins numerous, subtile, and very spreading; the peripheric veins somewhat distant from the margin; umbels stalked, axillary, solitary, three- to eight-flowered; calyces on conspicuous stalklets, the tube almost turbinate, nearly as long as or shorter than the semiovate-conic lid; stamens inflexed before expansion; anthers obovate, with contracted base, opening with longitudinal parallel slits; style short, twisted; fruit turbinate-hemispheric, three- to five-celled, dilated around the margin, their rims narrow; valves exserted, short; seeds without appendage.

On river-banks from Swan River to Cape Leeuwin, and eastward at least as far as the Gardiner river.

This species has been described and illustrated on this occasion, not as an important timber-tree—its wood serving seemingly for little else than fuel—but to demonstrate the uncertainty of vernacular names bestowed by colonists on Eucalypts in various parts of Australia. Thus we have not less than three distinct Flooded Gum-trees in Western Australia alone—viz., Eucalyptus rostrata, E. rudis, and E. decipiens. The last-mentioned species is described also by Dr. Endlicher, of Vienna, in the quoted work of the nobleman (and subsequent ambassador) who visited the country between Swan River and King George's Sound as long ago as 1833, and brought with him for scientific elucidation a host of West Australian plants, at a time when so little especially of the Swan River vegetation was known. Eucalyptus decipiens differs already from E. rostrata and E. rudis in having its flowers and fruits sessile on the general stalk, also in the form and dehiscence of its anthers, which are globular and open rather by pores than by slits. Neither Eucalyptus rudis nor E. decipiens are very large trees; and both, on account of their persistent rough bark, belong to Rhytiphloiae, being thus signally different from the valuable Flooded Gum-tree of the interior. The writer is unacquainted with any technic value which the wood of E. decipiens may possess; but E. rudis deserves notice on this occasion, as being among the few West Australian species which would furnish lucrative material for the distillation of the antiseptic and also industrially so valuable Eucalyptus oil.

Explanation of Lithogram. Plate IX.

1. Longitudinal section of a flower bud; 2. Front view of stamen; 3. Back view of stamen; 4. Pistil; 5. Longitudinal section of fruit; 6. Transverse section of fruit; 7. Sterile seeds; 8. Fertile seeds; 9. Embryo; 10. Cotyledons moved asunder to show the radicle.—All analytic details enlarged. The branchlet with broad leaves in the background represents, in this and all other Plates, the species in its youngest state.

11. *Eucalyptus decipiens.* Endlicher, in Huegel's Enumeratio Plantarum Novae Hollandiae Austro-Occidentalis, 49 (1837). Bentham's Flora Australiensis, iii. 218. One of the Flooded Gum-trees of South-West Australia.

Leaves scattered, from ovate to lanceolar, acuminate, dull green on both pages; their subtile veins very divergent, the peripheric vein somewhat distant from the margin; flowers axillary, from five to fifteen, crowded on a short stalk without separate stalklets; tube of the calyx turbinate, as long as or shorter than the broad- or narrow-conical lid; stamens inflexed before expansion; anthers minute, spherical, opening rather with pores than slits; fruit small, its form fluctuating between turbinate and truncate-globular, the rim somewhat broad and flat; valves emersed; seeds without appendage.

From Swan River to Cape Riche, especially along watercourses or on river-flats, but occasionally also on limestone-hills.

For further observations, see preceding species. The geographic range of this, and indeed of most of the West Australian Eucalypts, is as yet not accurately ascertained.

Explanation of Lithogram. Plate X.

1. Operculum; 2. Stamens in bud, outer view; 3. Longitudinal section of flower bud; 4. Front view of stamen; 5. Back view of stamen; 6. Pistil; 7. Longitudinal section of fruit; 8. Transverse section of fruit; 9. Sterile seeds; 10. Fertile seeds; 11. Portion of a leaf.—All (but variously) magnified, but the main figure of natural size.

12. *Eucalyptus microtheca.* F. von Mueller, in the Proceedings of the Linnean Society, iii. 87 (1858). *E. brachypoda, Turcz.;* Bentham's Flora Australiensis, iii. 223.

Leaves scattered, on rather short stalks, narrow-lanceolar and somewhat sickle-curved, opaque on both sides, faintly veined, the intra-marginal vein almost contiguous to the edge; umbels few-flowered, mostly in terminal panicles; calyx very small, its tube hemispheric, about as long as the almost conical lid; stamens very short, inflexed before expansion; anthers extremely minute, globular; fruit very small, semiglobular or semiovate, three- to four-celled; valves somewhat exserted; seeds without appendage.

From the Murchison river scattered northward as far as Cambridge Gulf, also widely distributed through the vast interior of Australia, particularly along occasionally wet depressions, reaching to the Flinders and Darling rivers, and also nearly to the east-coast of Queensland.

Usually this tree is not very large, though of sufficient dimensions to yield timber, and it exceptionally attains 150 feet in height. It belongs to the Rhytiphloiae, or perhaps to Hemiphloiae, as the bark is only partially persistent on the branches. It is fond of swampy ground like Eucalyptus rostrata, with which it is associated in many places. The wood is lasting in and out of the ground, hence well adapted for waterworks, railway posts and sleepers, and a multitude of carpentry works; it is dark, hard, heavy, and elastic.

Explanation of Lithogram. Plate XI.

1. Longitudinal section of flower bud; 2. Front view of stamen; 3. Back view of stamen; 4. Pistil; 5. Longitudinal section of fruit; 6. Transverse section of fruit; 7. Sterile seeds; 8. Fertile seeds.—All analytic figures enlarged.

13. *Eucalyptus oleosa.* F. von Mueller, in Nederlandisk Kruidkundig Archief, iv. 137 (1859). Bentham's Flora Australiensis, iii. 248.

Leaves scattered, narrow- or oblong-lanceolar, on rather short stalks, recurved-acuminate, shining, dotted with innumerable oil-glands, faintly veined, the peripheric vein slightly distant from the margin; umbels stalked, axillary, solitary, four- to eleven-flowered; tube of the calyx obconic or semiovate, usually on a very short stalklet, hardly angular, shorter than the mostly conical blunt or acute lid; stamens short, inflexed before expansion; anthers minute, ovate, with parallel distinct cells; fruit small, truncate-ovate or almost truncate-globular, three- or four-celled; valves subulate, exserted; seeds without appendage.

In the interior extra-tropical desert-country, forming a portion of the so-called "Mallee-scrub," which extends over a vast portion of the deserts of Australia.

This species remains often in a bushy state only, but attains also the size of a small tree. The bark is mostly persistent on the trunk, but secedes from the branches; accordingly Eucalyptus oleosa belongs to the series of Hemiphloiae.

It is nearly allied to Eucalyptus uncinata (Turczaninow, in Bulletin de la Société des Naturalistes de Moscow, 1849, ii. 23), which forms also a constituent of the Mallee-scrubs, but in that Eucalypt each anther cell opens by a minute pore. Eucalyptus oleosa had no claims to be enumerated among the timber-trees of the western colony, but the oil obtainable from its foliage is so valuable and peculiar that this Eucalypt could not well be excluded from the present document. Its oil was among the numerous new technologic articles exhibited by the writer at the second London Exhibition in 1862. Its specific gravity is 0·911; it is the best known solvent of amber and other fossil resins and of India-rubber, and has proved unique in many technologic applications.

This tree, though too small for timber, is important for the large yield of oil from its foliage.

Explanation of Lithogram. Plate XII.

1. Four forms (three abnormal) of the calyx; 2. Longitudinal section of unexpanded flower; 3. Front view of stamen; 4. Back view of stamen; 5. Pistil; 6. Three varieties of fruit; 7. Longitudinal section of fruit; 8. Transverse section of fruit; 9. Sterile seeds; 10. Fertile seeds.

14. *Eucalyptus longicornis.* F. v. Mueller, Fragmenta Phytographiae Australiae, xi. 14 (1878). The Morrell-tree.

It is needless to devote to this Eucalypt a special description, as most probably it constitutes a mere variety of the preceding. It differs, however, in its comparatively tall stature, attaining a height of 120 feet, and perhaps more; the leaves are longer and more lustrous, the stalks and stalklets of the flowers are also longer, and the lid—from which the name "longicornis" became derived—is hornlike-elongated.

On the sources of the Swan River it is interspersed with E. loxophleba and E. salmonophloia, extending thence eastward. It agrees with the York Eucalypt in its bark, with the salmon-barked Eucalypt in its foliage, from which latter it is easily distinguished by the longer and more pointed lid, the elongated style and the evidently larger fruits. The leaves are equally rich in oil, so that probably after E. salubris (which like E. amygdalina yields nearly four per cent. of oil from the fresh foliage), both the Morrell and the Salmon-bark Eucalypt would rank among West Australian congeners next in the yield of this valuable volatile fluid. The oil is obtained in the most profitable manner by passing steam through the foliage in a still.

The wood is nearly as dark as that of E. marginata; it is remarkably hard, and used for rafters, shafts, naves, spokes, harrows, and all kinds of wheelwrights' work. Straight and lasting rails up to twenty-five feet in length can be obtained from young trees.

Explanation of Lithogram. Plate XIII.

1. Longitudinal section of flower bud; 2. Anterior view of stamen; 3. Posterior view of stamen; 4. Style with stigma; 5. Longitudinal section of fruit; 6. Transverse section of fruit; 7. Sterile seeds; 8. Fertile seeds; 9. Embryo; 10. Cotyledons pressed outward, to lay free the radicle; 11. Elongated flower buds of a variety with longer stalklets.—All analytic details, except 11, magnified.

15. ***Eucalyptus salmonophloia.*** F. v. Mueller, Fragmenta Phytographiae Australiae, xi. 11 (1878). The Salmon-barked Eucalypt.

Leaves scattered, of rather thin consistence, sickleshaped-lanceolar, shining and equally green on both sides, copiously dotted with pellucid oil-glands; the veins concealed, the peripheric vein but little removed from the margin; umbels axillary, solitary, with few or several flowers; stalklets very thin, nearly three times shorter than the almost cylindric flower-stalk, but about as long as the semiovate tube of the calyx; lid semiovate-conical, slightly exceeding the length of the tube; stamens very short and all fertile; the outer filaments flexuose-erect before expansion, the inner ones inflexed while in bud; anthers cordate- or renate-globular, bursting by longitudinal slits; fruit small, semiovate, three- or rarely four-celled; valves long-exserted, very narrow and pointed; seeds minute without any appendage.

From the upper regions of Swan River, as far as the vicinity of Victoria Springs, occurring in interrupted patches.

This tree attains a height of about 100 feet. The grey and slightly-purplish smooth bark is of an oily lustre, which characteristic has suggested the vernacular name of the tree. Of the quality of the timber not much is known; it has furnished, however, good fence-wood. Here it was deemed desirable to allude to the tree, because it is one of the few in West Australia yielding on distillation a large quantity of oil from the foliage. The export of the seeds of this species and of those of any other kinds rich in oil may become important, as these Eucalypts are so much sought to subdue malarian evaporations. The nearest affinity of the Salmon-barked Eucalypt is to E. oleosa, but it differs in its entirely smooth bark, the smaller flowers and fruits, and the shorter and also blunter lid of the calyx.

Explanation of Lithogram. Plate XIV.

1. Longitudinal section of flower bud; 2. Lid of calyx removed to show the direction of the outer stamens; 3. Front view of stamen; 4. Back view of stamen; 5. Pistil; 6. Longitudinal section of fruit; 7. Transverse section of fruit; 8. Sterile seeds; 9. Fertile seeds; 10. Embryo; 11. Cotyledons bent to exhibit the radicle.—All analytic figures magnified.

16. ***Eucalyptus salubris.*** F. v. Mueller, Fragmenta Phytographiae Australiae, x. 54 (1876). The Gimlet-wood or Fluted Eucalypt.

Leaves scattered, sickleshaped-lanceolar, on both sides equally green and very shining, perforated by very copious oil-dots; the veins ascending in a very acute angle, the peripheric vein but little distant from the margin; umbels axillary, solitary, few-flowered; stalks linear-cuneate, very compressed; stalklets as long as the semiovate tube of the calyx or up to twice as long; lid semi-ellipsoid, very blunt, twice as long as the tube of the calyx; stamens inflexed before expansion, all fertile; anthers oval-oblong, dehiscent along the margin, their two cells separated in their whole length by a broad connective; fruit small, semiovate, three- to four-celled; valves short, deltoid, emersed; seeds without appendage.

From the upper Swan River extending as far as the Victoria Springs, where it was first met in Giles's expedition, forming small forests in various places. Its further distribution remains hitherto unascertained.

This tall but slender tree is remarkable for the broad longitudinal often twisted impressions or roundish blunt longitudinal ridges of its stem. The bark is smooth, shining, and of a brownish tinge. The length of the stem up to the first branch reaches not rarely 100 feet. The wood serves for poles, shafts, rails; although tough it is worked with comparative ease; it is harder and paler than Morrell-wood, and proves to me the best of all for wood-engraving known from

West Australia. The extraordinary abundance of oil in the leaves, approximately four per cent. in the fresh foliage, points this species out as the leading one in West Australia for oil distillation, its yield in this respect being as rich as that of Euc. amygdalina of Victoria, Tasmania, and New South Wales, many thousand pounds' worth of that oil having been exported from Melbourne from Mr. Basisto's factory.

Explanation of Lithogram. Plate XV.

1. Calyx of two varieties, natural size; 2. Operculum moved from the calyx-tube to exhibit the stamens while in bud; 3. Longitudinal section of unexpanded flower; 4. Front view of anther; 5. Back view of anther; 6. Pollen grains, 250 times diametrically enlarged; 7. Pistil; 8. Longitudinal section of fruit; 9. Transverse section of fruit; 10. Sterile seeds; 11. Fertile seeds; 12. Embryo; 13. Cotyledons torn asunder to lay free the radicle; 14. Portion of leaf showing venation and oil-dots.—All details, except 1, magnified.

17. *Eucalyptus angustissima.* F. v. Mueller, Fragmenta Phytographiae Australiae, iv. 25 (1863). Bentham's Flora Australiensis, iii. 238.

Leaves rather small, scattered, broadly linear, thinly acuminate, on very short stalks, equally green and shining on both sides, perforated by very numerous oil-dots; the veins almost concealed; flowers from two to four on short axillary, solitary, almost cylindric stalks, and provided with only very short stalklets; lid semiovate or somewhat conical, nearly twice as long as the hemispheric not angular tube of the calyx, and slightly narrower; stamens inflexed before expansion; anthers minute, almost heart-shaped, opening by longitudinal slits; fruits very small, almost hemispheric, three- to four-celled, slightly contracted at the convex rim; valves deltoid; seeds without appendage.

On the western side of the Great Bight, discovered by Mr. Maxwell.

The precise geographic limit of this Eucalypt remains as yet unknown; it belongs probably to the tertiary limestone formation, and may thus have a very extensive range. It is allied in many respects to E. salubris, but the flower stalks are not dilated, while the leaves are narrower than in any other Eucalypt.

The species, though mostly of shrubby growth, has found a place in this document in order to draw attention to the copiousness of its volatile oil, more especially as various sorts of Eucalyptus produce considerably different oils, and these not alike available for special technic purposes.

Only a shrubby species, but peculiar to West Australia, and structurally remarkable.

Explanation of Lithogram. Plate XVI.

1. Longitudinal section of unexpanded flower; 2. Front view of stamen; 3. Back view of stamen; 4. Style with stigma; 5. Longitudinal section of fruit; 6. Transverse section of fruit; 7. Seeds.—All magnified.

18. *Eucalyptus megacarpa.* F. v. Mueller, Fragmenta Phytographiae Australiae, ii. 70 (1860). Bentham's Flora Australiensis, iii. 232. The Blue Gum-tree of West Australia.

Leaves scattered, sickleshaped-lanceolar, of firm consistence, the veins subtile and hardly prominent, the peripheric vein but slightly removed from the margin; flowers one to three, often two, large, axillary, sessile on a thick and very compressed stalk; tube of the calyx turbinate, not angular, with a prominent margin; lid smooth, hemispheric, pointed; stamens all fertile, inflexed before expansion; anthers oval-oblong, opening with parallel longitudinal slits; fruit truncate-globular, large, four- to six-celled, with convex and not channelled rim; valves emersed; seeds angular, shining, without any appendage.

Sparsely occurring from the vicinity of King George's Sound to Cape Leeuwin, occasionally ascending the tops of mountains.

This tree is very different from the celebrated Blue Gum-tree of Tasmania and Victoria—namely, Eucalyptus globulus—never attaining the enormous size of that species, seldom, indeed, exceeding 100 feet in height, differing also much in its floral characters and in its fruit. The bark is smooth, hence E. megacarpa ranks among the Leiophloiae. Of the value of the timber almost nothing is known. The specific name is derived from the comparatively large size of the fruit.

19. *Eucalyptus pyriformis.* Turczaninow, in Bulletin de la Société des Naturalistes de Moscow, 1849, ii. 22. Bentham's Flora Australiensis, iii. 226.

Leaves scattered, of thick consistence, oval-lanceolar, acuminate, with spreading parallel very fine veins, the peripheric vein slightly distant from the margin, the oil-dots hardly visible; flowers very large, one to three together on thick cylindrical finally recurved and often elongated stalks; calyx red, its tube semiovate, with two to four prominent angles, tapering into conspicuous stalklets; lid semiovate-hemispheric, short pointed, nearly as long as the tube of the calyx; stamens inflexed before expansion, all fertile; anthers ovate-cordate, opening by parallel longitudinal slits; fruit of very large size, hemispheric-turbinate, two- to four-angled, four- to six-celled, the broad rim ascending from the concave edge; valves enclosed; seeds without appendage.

This highly remarkable species has found a record here not as a timber-tree (for it is mostly of shrubby growth), but as deserving culture for ornamental purposes, its red calyx and long stamens being showy conspicuous.

The shape and size of the calyx gave rise to the specific name. Several other large-flowered Eucalypts are peculiar to Western Australia, for instance: E. macrocarpa (Hooker), E. Preissiana (Schauer), E. tetraptra (Turczaninow), E. ptychocarpa, E. erythrocorys, and E. Youngiana (F. v. M.), the seeds of all which could be made an article of commerce.

This is only a shrubby species, but as it is much sought in horticulture on account of its *red* calyx it is well worthy to be included in the West Australian Eucalyptus Atlas, the sale of the seeds being an industrial resource.

Explanation of Lithogram. Plate XVII.

1. Transverse section of unexpanded flower; 2. Front view of stamen; 3. Back view of stamen; 4. Style with minute stigma; 5. Longitudinal section of unripe fruit; 6. Transverse section of young fruit; 7. Sterile seeds; 8. Fertile seeds.—All enlarged.

Besides the species enumerated several other Eucalypts pass in Western Australia under vernacular names—thus Eucalyptus patens (Bentham) is the Blackbutt-tree there; the Spearwood is E. doratoxylon (F. v. M.); the Yatthae is E. foecunda (Schauer); while several well-defined tropical species pass as Bloodwood-trees, Stringybark-trees, Box-trees, &c.

With the economic properties of these species we are as yet almost unacquainted.

B.—*Timber Trees not Eucalypts.*

It may suffice to offer merely cursorily some notes without descriptions on the other principal trees of technic value, occurring in West Australia, not belonging to the genus Eucalyptus. Among them the Casuarinas are for wood perhaps the most important.

Casuarina Fraseriana (Miquel) yields there one of the most elegant furniture woods and a splendid and extensively used material for shingles.

Casuarina glauca (Sieber) is one of the interior desert-trees of considerable size; the wood is hard and durable.

Casuarina Decaisneana (F. v. M.) is the Central Australian species, which enters the remote eastern portion of the colony. The few other tall congeners are of less importance, although every one of them furnishes excellent fuel.

Agonis flexuosa (Schauer). The Peppermint-tree of many of the river banks and humid valleys. Attains a height up to seventy feet. Wood sought for various implements, and also for superior fuel.

Melaleuca Leucadendron (Linné). The tropical Paperbark-tree. On river banks in the intra-tropical districts. The tree attains 100 feet in height, or more, and can be planted on wet saline ground, even on tidal streams. The hard wood resists the white ants, and is available for many kinds of building purposes and various artisans' work, also for shipbuilding. Several species of very tall Melaleucas pass in the extra-tropic districts as Paperbark-trees, and their wood may perhaps prove as valuable as that of the northern species. They are all important for subduing malaria in swamps even of brackish water.

Frenela verrucosa (Cunningham). This is the most widely-distributed Cypress Pine of Western Australia, valuable for its splendid wood and also for its resin, which is very similar to the Sandarac from the Callitris Pine of Northern Africa.

Banksia verticillata (R. Brown). The River Banksia of West Australia, confined to moist valleys. It rises to seventy feet or even more. The beautiful pale and soft wood is sought by joiners for furniture, sashes, and many other purposes, for which otherwise deal is used. The other congeners, which form good-sized trees in West Australia, are Banksia littoralis, B. attenuata (the narrow-leaved Banksia), B. Menziesii, B. ilicifolia (the prickly Banksia), all named by R. Brown, and B. grandis (Willdenow).

The species on the North-West coast is B. dentata (Linné).

Santalum cygnorum (Miquel). From the vicinity of the great Bight to Shark Bay. The fragrant Sandal-wood of West Australia, which for many years past has been so largely exported, is derived from this species.

Acacia acuminata (Bentham). The raspberry-scented Acacia. A small tree widely-distributed through extra-tropic West Australia. It yields lasting fence-posts, though its scented and hard wood should realise a good export price for ornamental wood-work, on account of its fragrance. It furnishes the best of charcoal in West Australia.

Acacia saligna (Wendland). A small tree, common in most parts of extra-tropic West Australia, at least towards the coast. Its bark is as rich in tannic acid (up to thirty per cent.) as that of Acacia decurrens, A. pycnantha, A. falcata, and A. harpophylla in East Australia. It is easily and quickly raised from seeds, even on poor sandy ground.

Acacia microbotrya (Bentham). The Badjong Acacia. This species yields an enormous quantity of superior gum, according to Mr. George Whitfield, sometimes as much as fifty pounds weight from a single tree.

Several other Acacias produce in West Australia fragrant wood, tanners' bark, and mimosa gum, but which precise species is as yet not well known, more than 150 Acacias standing already on record from the hitherto explored portions of the Western Australian territory, although the majority of them are shrubby kinds. The seeds, however, of every sort would be acceptable for horticultural export trade, Australian Acacias being always in request for European glass-houses, to aid in a display of very early spring-flowers and odd foliage in conservatories. Very few of the West Australian species are as yet under cultivation.

II.—CHEMICAL AND MICROSCOPICAL EXAMINATION OF EUCALYPTUS-WOOD.

Conspicuous ingredients of Eucalyptus-wood, irrespective of such as are found in all other kinds of timber, are Kino-tannic acid, which readily dissolves in water and alcohol, and Phlobaphen or a closely allied pigment, only soluble in alkaline liquids, and re-precipitable on neutralisation by acids. The comparatively large development of phlobaphenic pigment has on this occasion been demonstrated in the wood of Eucalyptus marginata and Eucalyptus rostrata; and it is a significant fact, that just these two kinds of wood more than any other among the Eucalypts resist decay by antiseptic ingredients for long periods, when immersed in soil or water, or when otherwise exposed to disintegrating influences. This peculiar form of Phlobaphen seems to owe its origin to changes produced in the tannic acid. The pigments contained in Eucalyptus diversicolor, E. longicornis, E. calophylla, E. loxophleba, E. salubris, E. cornuta, and also E. globulus (which were the only kinds of wood subjected at present to comparative experiments in this respect) are chemically indistinguishable, so far as the tests went, but differ in some optical characters, as observed by Mr. L. Rummel, who has ably aided me in these microscopic and chemical investigations. In all probability the Phlobaphen is elaborated from the tannic sap, and deposited gradually while the new growth of wood matures; hence it is most richly stored up when the main activity of the circulation has ceased. It is not merely on account of the diminished humidity contained in the wood at the end of the dry season, or at the annual termination of its cyclus of life, but also in consequence of the phlobaphenic substance having then become fully elaborated with other elements of the mature wood, that timber will prove in the highest degree durable, when felled towards the end of the summer, before heavy autumnal rains start the circulation anew for another year's growth. I am aware that it is at present beyond possibility to restrict at large colonial sawmills the operations for cutting trees to a very limited period of the year; still such timber, as is needed for exceptional purposes of resistance, should be secured during the late summer months. Whether to this generally recognised rule any exceptions exist in Western Australia—be it from climatic circumstances or from special peculiarities of the timber there—can only be ascertained by local test and experience, for which no opportunities have arisen to myself.

It is likely also, that the durability of the Eucalyptus-wood may partially depend on the quantity of oleo-resin, bitter of taste and soluble in alcohol, by which it is more or less pervaded. To fix the respective quantity of this oil-resin of various Eucalyptus-woods must remain the object of subsequent researches, no time being allowed to enter on a set of investigations of this kind for the present document.

In Eucalyptus marginata the phlobaphenic particles fill up as a brown and pellucid mass the cavities of most of the vascular and cellular tissue, at least in the harder kinds of wood of that species, which is obtained from mountain regions. In the lighter and softer kinds of Yarrah-wood the Phlobaphen occurs in far lesser quantities. In Eucalyptus rostrata both vascular and celullar cavities are very extensively filled with the phlobaphenic substance; in the other kinds of wood subjected to examination for this Report, the Phlobaphen occurs chiefly in the vascular tubes and fills them far less completely.

TABLE.

In 100 *parts of Air-dried Wood of*

	Phlobaphen.	Tannic Acid.	Water.
Eucalyptus marginata (hardest)	16·50	0·05 to 4·75	12·05
Eucalyptus rostrata	16·62	4·38	9·00
Eucalyptus diversicolor	7·75	5·50	13·63
Eucalyptus calophylla	7·00	2·25	12·75
Eucalyptus loxophleba	4·40	4·00	10·00
Eucalyptus longicornis	4·25	3·90	11·12
Eucalyptus salubris	3·60	2·50	14·38

The results rest, however, on solitary analysis only except in reference to the Phlobaphen of Eucalyptus marginata, where the average of three tests is given.

The West Australian Eucalyptus-woods, when dried, vary very considerably in specific gravity. Those of Eucalyptus cornuta, E. loxophleba, E. salubris, and E. longicornis sink in water at once; that of the harder kind of E. marginata and those of E. calophylla, E. diversicolor, and E. rostrata sink only after soaking; that of the lighter kind of E. marginata remains lighter than water under any circumstances.

Specific Gravity of Air-dried Wood, ascertained by the Hydrostatic Method.

Eucalyptus cornuta	1·235
Eucalyptus loxophleba	1·090
Eucalyptus longicornis	1·060
Eucalyptus salubris	1·040
Eucalyptus marginata (hard)	0·970
Eucalyptus rostrata	0·970
Eucalyptus calophylla	0.970
Eucalyptus diversicolor	0·935
Eucalyptus globulus	0·875
Eucalyptus marginata (soft)	0·820

The vascular tubes of each kind of Eucalyptus-wood vary in size within certain limits; they are, however, always very much larger and consequently always much less numerous in E. marginata, E. diversicolor, E. longicornis, E. calophylla, and E. rostrata (also E. globulus), than in E. loxophleba, E. cornuta, and E. salubris.

The woody fibre (Prosenchyma or Pleurenchyma) is remarkably different in reference to the thickness of its walls, and the lumen of its cavity in different kinds of Eucalyptus-woods. In E. cornuta, E. salubris, and E. longicornis, the cavity is very small in proportion to the thickness of the walls; that of E. cornuta is the narrowest of all, the lumen being many times smaller than the walls. In E. marginata the width of the cell of the ligneous fibre is variable, according to different sorts of wood, but it is never so wide as in E. rostrata (and also E. globulus), but about the same diameter as in E. diversicolor. Intermediate in this respect between the above-contrasted species are E. loxophleba and E. calophylla. These observations need repetition on ampler material.

The cellular substance (Parenchyma) is more or less copiously distributed throughout the mass of the wood in various Eucalypts, and more generally developed around the vascular tubes. Its cells have usually about the same diameter as the ligneous fibres, but their walls are thinner. In the light kind of wood of E. marginata, in E. globulus, and E. calophylla, the diameter is larger than that of the Prosenchyma. How far this will prove constant in wood of different ages and from distinct localities remains to be ascertained. The wood of E. salubris is remarkable for the comparative paucity of its Parenchyma-cells, their number being six times less than in E. calophylla and E. loxophleba.

The medullary rays in all the West Australian Eucalyptus-woods, subjected to examination for the present purpose, consist usually of no more than two rows of cells ; in E. rostrata medullary rays of three series occur. The breadth of the medullary rays, as a rule, decreases in proportion to their distance in various kinds of these woods; the width of single rows is generally greatest in E. diversicolor and narrowest in E. salubris.

In conclusion, it may be summed up that the capability of different kinds of Eucalyptus-wood to endure for lengthened periods the destructive contact with humidity, air, and temperature depends largely, and perhaps mainly, on phlobaphenic substance unchangeable by water ; further probably also on the occurrence of oleo-resin, on the reduced number of hollow vascular tubes, on the organisation of the walls of the ligneous fibre, on the decreased copiousness of parenchymatic substance, and on the lesser space occupied by the medullary rays. The hard variety of Yarrah-wood fulfils most of these conditions, eminently so of the first one, and the same may be said of E. rostrata. It must, however, be remarked that nearly all the above observations, as here now instituted, refer only to solitary samples of wood, whereas it is but reasonable to suppose that wood from different trees or portions of trees, even of the same species, when grown in different soils and climes, would vary in some respects ; nevertheless it is likely that the relative superiority of one sample of Eucalyptus-wood over another would always clearly and instantaneously be demonstrated by the aid of the microscope and according to recognised chemic and anatomic principles, which continued experimental research is likely to affirm as reliable.

III.—CULTURAL MEASURES TO ENRICH THE WEST AUSTRALIAN FORESTS.

Although the colony is so very rich in durable hard woods, it is nowhere extensively endowed with trees of the soft wood classes, and it is almost totally devoid of timber which could readily be utilised instead of deal, red cedar and many other kinds of easily workable wood, such as are in daily demand by artisans. Indeed, every country should strive to place itself, regarding timber-resources, in a position of independence, so far as climatic circumstances will permit ; and in this respect West Australia is most happily situated, its wide territory, stretching through twenty-two degrees of latitude, admitting in reality of the culture of almost every kind of utilitarian tree in existence anywhere.

West Australia possesses three principal or extreme climatic regions, though through many tracts they verge into each other :—

A. The humid cool forest-country.
B. The dry regions, particularly inland.
C. The tropical coast-tracts.

All three demand foreign trees and other cultural plants, selected purposely for each.

A. *In the southern forest regions,* where Yarrah- and in some districts Karri-trees prevail, all kinds of utilitarian plants, requiring a comparatively cool and humid atmosphere, should be brought under test with a view to final selection from them for culture and naturalisation. The renowned Wellingtonia- and Sequoia-pines, which in their colossal dimensions exceed even the Karri-Eucalypts, the Oregon-pine (Pinus Douglasii), the great Silver-fir (P. grandis), the lofty Sugar-pine (P. Lambertiana), Menzies'-pine, the yellow Pitch-pine (P. ponderosa), which with Pinus Sabiniana and

P. Lambertiana produces edible nuts, and the Nutka-cypress, all from North-Western America, could be reared for pine-timber in the forest-tracts between Swan River, Cape Leeuwin, and King George's Sound. It is also there, where the Weymouth-pine (Pinus strobus) which yields us mainly the white deal of the eastern United States, the two principal American Pitch-pines (P. australis and P. rigida), the white Cedar-cypress, the Thuya occidentalis, the Virginian Swamp-cypress (Taxodium distichum), and many others of the fir-tribe from eastern North-America, would find their place. The Lebanon-cedar with its Himalayan Deodar-variety, the Bootan-pine (Pinus excelsa), the Cheer-pine (P. longifolia), the Dye-pine (P. Webbiana), the Nepal Nut-pine (P. Gerardiana), with many other Asiatic species, the tall Nepal-cypress (Cupressus torulosa), then the Silver-fir of Middle Europe (Pinus Abies), and the Norway-spruce (P. Picea), would also in the Yarrah- and Karri-forests rapidly attain a great height.

To these ought to be added, so far as coniferous trees are concerned, all kinds of Kauris, especially that of New Zealand, chiefly for masts and spars, the Totara or Mahogany-pine of the same islands, the various kinds of Larches (in the coolest places), the Sugi (Cryptomeria), the Hinoki (Cupressus obtusa), the Thuyopsis, the Gingko of incalculable longevity—the four last-mentioned from Japan, the Gingko being there the grandest of all—the Pencil-cedars (Juniperus bermudiana, J. virginiana, J. chinensis), with some other congeners should, as highly desirable, not be passed on this occasion, nor the nut-bearing Araucarias of Brazil and Chili, all important for yielding pine-timber. The Norfolk Island and the Moreton Bay Araucarias, of which A. Bidwilli further yields edible nuts, are established at many West Australian domiciles already, and could advantageously be grown in West Australia as forest-trees.

Among trees not coniferous might be introduced into the most south-western forests large numbers of the best of Oaks, particularly the White Oak (Quercus alba), the best of all for coopers' use and highly important for shipbuilding, the Burr Oak (Q. macrocarpa) and the Live Oak (Q. virens) of North America; also the British Oak, and numerous other species, either evergreen or deciduous, from both hemispheres. The Cork Oak (Q. Suber) and the Valonia Oak (Q. Ægilops) would also thrive best in these forest regions, although they might be planted as well in drier localities for bordering roads and streets. Speaking of avenue-trees, I may be permitted to observe that one of the most splendid among those of evergreen verdure which can be chosen is the tall Grevillea robusta of East Australia, which vies with the Nuytsia in the brilliancy of its flower, but surpasses it far in the ease with which it is reared and in the excellence of its timber. The ordinary Walnut-tree, as well as the North American Butter-nut and Black Walnut-trees, and the allied Hickories (Carya alba, C. glabra, C. microcarpa, C. tomentosa, C. sulcata, and C. oliviformis) are all recommendable for transfer to the West Australian forests on account of the excellence of their peculiar wood, irrespective of the value of their fruits, those of the Shellbark Hickories (Carya alba and C. sulcata) and of the Pecan-nut (C. oliviformis) rivalling the European Walnuts. The evergreen Nut-tree of East Australia (Macadamia or Brabejum ternifolium) together with the allied Chilian Hazel (Guevina Avellana) should mingle as denizens of the southern forest-trees of Western Australia. The hardiest Indiarubber-tree (Ficus elastica) deserves also introduction there. It is in the south-western forests also where large plantations of the hardy Red Cedar of East Australia and India (Cedrela Toona) and likewise that of South America (Cedrela brasiliensis) should be reared for one of the best and most easily worked of furniture woods, which from the exhausted "Cedar brushes" will ere long be no more obtainable. The Sweet Chestnut-tree deserves the fullest attention both for its timber and its nuts, whether in forest land or for shading roads or streets. The North American Sugar Maple with many of its congeners, as well as some of the best Ash-trees from both hemispheres, could also advantageously be introduced into the forests of West Australia. It would be easy enough to transfer Beeches, particularly the beautiful evergreen species of East Australia, Tasmania, and New Zealand, to the banks of watercourses in the Karri-forests, if their wood was deemed requisite. The Blackwood-tree of South-East Australia (Acacia melanoxylon) deserves special attention for the sake of its magnificent wood, which for furniture, as well as for carriage- and boat-building, staves, &c., has come most extensively into use; its bark moreover contains as much as twenty-eight per cent. of tannic acid.

Though West Australia is so rich in Eucalypts, yet the East Australian E. citriodora might well become an inmate of plantations there on account of the exquisite fragrance of its foliage and the essential oil to be distilled therefrom. Hazels, Filberts, Bamboos, Poplars, and Osier-willows (among the latter especially Salix purpurea, S. rubra, S. viminalis, and S. triandra) set quickly a barrier to bush-fires, if planted along rivulets; the last-named yield simultaneously the most valuable products for basket manufacture, the best charcoal for gunpowder, and the medicinal salicine. Concomitant with tree culture the formation of tea-plantations could proceed in all the south-western forest valleys, as the Chinese (or rather Assam) Tea-bush would prove quite hardy, and in the humid valleys particularly prolific also. The simplified processes in preparing the young leaves (as pointed out in a printed essay of mine from recent Upper Indian experiences) would render tea-culture in the Yarrah- and Karri-forests most remunerative, and could afford occupation to the juvenile and infirm among the labouring classes, as would in irrigated valleys the culture of the Hop-plant. The Turkish Box-tree also, the wood of which cannot be fully replaced by that of any other tree for xylography, is likely best developed to the requisite dimensions in the forest-land, wherever the soil contains a considerable quantity of lime. Even the Peru Bark-trees (Cinchonas) would adapt themselves to these sheltered and equally temperate regions, they having flowered in Victoria as far as 38° S. unprotected.

The Rhea- or Ramee-fibre (from Boehmeria nivea) and similar textile material from some allied bushes of the genera Debregeasia, Maoutia, Pipturus, Villebrunia, and Touchadi, all preferring a moist clime, could also best be produced in the forest-valleys.

An essay of mine on such fibre-plants, as are adapted for extra-tropic Australia, appeared in print a few years ago. Quite a legion of forest-grasses from different parts of the globe might likewise be easily disseminated through these sylvan regions. Among the latter I would merely single out Bromus asper, Festuca gigantea, Melica nutans, Milium effusum, and Poa nemoralis, as among the English species, the gigantic Festuca dives of Victoria, which when once raised would be sure to spread on its own accord through all the moist portions of the woodlands. Similarly the still more nutritious Prairie-grass (Bromus unioloides) should be dispersed. The Falkland-island Tussock-grass may live in the coldest sandy heath-moors.

It is beyond the scope of this document to adduce all the most important plants from which new treasures could be obtained in the genial forest-clime of West Australia, but while referring for further information to my work on "Select Plants," I will conclude this passage by merely pointing out yet, that a multitude of forest fruits, such as the British Bilberry (Vaccinium myrtillus), the Canadian large Cranberry (V. macrocarpum), the Blueberry (V. pennsylvanicum), some Gaylussacias, and the Blackberries (among them the North American Rubus occidentalis, R. macropetalus, R. canadensis, R. villosus, R. trivilis) could with very little care and expenditure be naturalised along the forest-brooks with species of Rubus and Fragaria. By the mere scattering of the dust-like spores of fern-trees (among which the South-East Australian Dicksonia antarctica and Alsophila australis and the New Zealandian Cyathea dealbata and C. medullaris are grand and graceful in the extreme, the magnificent features of these noble productions of Nature could without the slightest difficulty in the course of time be impressed also on the forest-valleys of West Australia, to enhance the scenic beauty afforded by indigenous palm-like Zamias, which latter ought to become lucrative articles of export to conservatories abroad. In and out of the forests many hardy Palms, Bamboos, and also the various Yuccas, Fourcroyas, Agaves, Dasylirions, together with the New Zealand Palm-lilies (Cordylines), could be introduced into the landscapes cheaply and copiously for embellishment and scenic effect. Seeds of the Palm-lilies obtainable already millionfold from plants, reared by me around Melbourne, when merely thrown broadcast on open places at the forest-ravines, would raise these elegant forms of palm-like vegetation not merely for decorative grandeur, but also for the textile fibres of their foliage. The superb Rice-paper bush of Formosa could from hence furnish irrespectively its pith for solar hats. For the dissemination of truffles and the best of mushrooms forest ground is also always the most favourable, and efforts might be made for their introduction, when an insight into the manner in which these self-caring vegetables can be transferred to wide distances shall have been obtained.

When so many indications of the mildness of the West Australian climate are obtained, the wish cannot be suppressed to see the Chinese Date-plum or Kaki, regarded as the most delicious of all the fruits of Japan, associated with the colonial table-fruits. The North American Persimon, a congener of the Kaki, is a much hardier tree. None of the splendid Guavas seem as yet represented in the colony, nor the best of Passion-fruits or Granadillas; Passiflora ligularis is noted as one of the finest fruits anywhere in existence at Caracas, while in the Botanic Garden at Brisbane fruits were obtained from Passiflora macrocarpa weighing eight pounds. The Rena of Fiji, the Tongan and Society-islands (Spondias dulcis) ranks also as an important tree, yielding esculent fruits in copiousness. Nor has the South American Cherimoyer found its way to Western Australia, nor other Anona trees with edible fruits, nor the Sapodilla plum, nor the Chinese Hovenia and Litchi; many of these would thrive best in forest-lands. My work on "Select Plants," the re-issue of which for wide distribution in West Australia seems recommendable, gives fuller information also on this subject.

In West Australia the forest-fires are not so excessively destructive as in the eastern colonies, nor do they as there leave in ghastly deadness vast numbers of standing trees, after the burning element has swept through the woods; on the other hand, the woods of West Australia are charming at all times, no lifeless trees disfiguring the landscape, all fresh and ever verdant with Zamias, Xanthorrhoeas, and Kingias remaining unimpaired by the scorching flames. Nevertheless, the bushy vegetation and underwood, and all kinds of herbaceous plants, are at least periodically apt to be annihilated in the woody country, when the bush ignites; hence the same precautions, which are recommendable in the other colonies to interrupt the fires, must be adapted also in the Yarrah- and Karri-forests, to prevent the destruction of foreign plantations formed within their shelter or limits; watercourses, or bands of soil turned up by plough furrows, or stone-lines, where rocks or boulders are readily accessible, will often debar fire from ingress; or it may become advisable to border plantations of select value by any kind of vegetation not inflammable or not readily consumed by ignition. To plants fit for this purpose allusion has already been made; and in the same manner as for street-avenues or for road-lines such trees should have preference as will yield annually a return in utilitarian products, so also for these forest-fences, besides rows or copses of Mulberries, can be adapted many kinds of Blackberry bushes, Roses for Attar-distillation, and an almost infinite number of other productive plants fit to be reared into hedges.

B. *The dry inland regions* of West Australia, though possessing naturally little forest-timber, should not be left out of consideration in this recommendative Report, and should also be brought within the scope of forest surveillance. The more or less open or bushy land, whether belonging to the limestone, granitic, or sandstone formation, or to any other geologic age, offers however only a limited range for the choice of plants suitable for culture; but in proportion to the wide extent of these dry tracts of country stands also the importance of those plants, by the cultivation or natural dispersion of which such lands may be ameliorated and rendered infinitely more productive for pastoral and even sometimes for agrarian pursuits. A regularly organised forest administration of the colony must take charge also of these districts; and here the watchfulness of the forest department will be all the more needed, inasmuch as at least the present desert-area is for long periods not likely to be alienated from the possession of the Crown; yet even these desert-lands will afford ample scope for raising there not only woods, but also many other utilitarian plants, to enhance the public revenue gradually with but little original outlay. Pines again claim here, in a very high degree, our attention. In the southern districts, at least, several firs will endure perfectly well the dry slime, among them the Cluster-pine (Pinus Pinaster), the Stone-pine (P. Pinea), the common

Seacoast-pine (P. halepensis), all three from the countries bordering the Mediterranean Sea; further, the famed Pinus insignis from California (first introduced into Australia, and most copiously too, by the writer of this document), which, indeed, is the most rapidly-growing of all pines of the globe, and yet at the same time one of the most regardless to soil; all these, together with the gigantic and quick-growing Cupressus macrocarpa of California, can be raised even on the sands of the sea-coast, which will thus finally be converted into pasture-land. How far northward these firs would prosper in Western Australia remains yet to be ascertained. For several other coniferous trees, fit for dry and poor ground, I would refer to the "Select Plants."

In altogether timberless localities, at least in the more southern latitudes, no tree could be more quickly and easily raised for shelter, fuel, and hardwood-timber than the celebrated Blue Gum-tree of Tasmania and Victoria (Eucalyptus globulus). Very special allusion deserves a tree from the eastern colonies, the Acacia decurrens, for obtaining within a few years a revenue from very sterile land. This, the feather-leaved Wattle, attains a much greater height, grows with more rapidity, and produces a larger return of the richest tanners' bark, than any West Australian Acacia. It is here, however, not recommended as a timber-tree, although its wood serves for staves and various implements. This tall Wattle exudes also gum of mercantile value rather copiously. For Olive culture porous calcareous soils towards the sea-coast are best adapted, though these long-living trees of great fecundity are able to cope even with protracted drought.

But it is more particularly the grasses to which I wish to turn, for showing that through their gradual progress the most arid tracts of country can be rendered habitable. We have witnessed already what a marvellous effect the Cynodon Dactylon or Doab or Doorva grass, passing in West Australia as Couch grass, has already produced on some of the sand-lands of the colony; but in the same manner the Stenotaphrum americanum, called in Australia Buffalo grass, would operate there to subdue the worst of drift sand and cover it with lasting verdure. According to locality and soil various grasses of the genera Agrostis, Alopecurus, Avena, Chloris, Dactylis, Ehrharta, Eragrostis, Festuca, Lolium, Phleum, Melica, Poa, and in poor localities especially the best kinds of Andropogon and Panicum should be dispersed, as they are evidently destined, particularly the perennial species, to give nutritive pasture even to extremely arid and sandy tracts, if the dissemination is aided by the simplest means. Many large Andropogons and Panicums especially resist scorching hot winds in a remarkable degree, and will live on poor sand-land. Attention has also recently been called to Aristida prodigiosa as an important desert-grass from West Africa. Paspalum notatum from the Laplata-stream luxuriates there particularly on somewhat saline ground as a nutritive fodder-grass, whereas P. distichum of East Australia and South Asia is splendidly adapted to line watercourses and surround swamps with an exquisite verdure of turfy grass. The tall and fattening Sorghum Millets, and the Bairee (Pennisetum typhoideum) have also not yet found their way sufficiently widely through the colony. Special mention deserve the best Millet-grasses, such as the Coapin (Panicum spectabile), the Deccan-grass (P. frumentaceum), the Para-grass (P. molle), the Guinea-grass (P. maximum), but they need rich soil, and can also be introduced into open places of forest-land for pastoral gain. A most promising huge saccharine fodder-grass, the Euchlaena luxurians of Mexico, has recently come into notice, seeds of which have been sent also by the writer to the western colony.

What holds good for recommending these grasses applies with equal force to a multitude of fodder-herbs. Lucerne and various kinds of Clover (the Alsike-clover succeeding where the ground is too humid for Lucerne) ought to change the aspect of many parts of West Australia in years to come, and are likely destined to increase vastly the productiveness of numerous pastures there. Wherever the limestone formation exists, or where otherwise the soil is calcareous, many others of the leguminous fodder-herbs would thrive well, such as the Sainfoin, the Horseshoe Vetch (Hippocrepis comosa), the big Soola-clover (Hedysarum coronarium). The Fagopyrums are also easily dispersed over sand-land to raise the first vegetation. To swampy lands the tall Sesbanias, indigenous also in Northern Australia, can easily be brought for naturalisation, cattle being ravenously fond of these so-called wild pea-bushes. They furnish moreover the Dandri-fibre. Accounts of the extraordinary value of the Prickly Comfrey (Symphytum asperrimum) of the Caucasus are perhaps somewhat exaggerated; but in moist, or perhaps even moory soil, not easily otherwise utilised, this fodder-herb may prove of signal importance. Sumach and Scotino, for select dye and tanning purposes, can be reared also on comparatively dry ground. The Date-palm and the ordinary Fig-trees could never be planted in too large a number in the desert-regions. In calcareous soils of the less arid districts the culture of the Carob-tree of the Mediterranean regions (Ceratonia Siliqua) should be initiated and extensively encouraged, the saccharine pods being far more important as fattening fodder than the recently so much lauded Prosopis-beans. The growth of the Ceratonia however is slow, unless in marly forest-lands. The Congo-pea (Cajanus indicus), one of the best of pulse-bushes, has yielded in rich alluvial soil the almost incredible quantity of two tons of pea from an acre; a further recommendation of this shrub is its adaptability also to dry ground. Annual Gram-plants ought to become redisseminated spontaneously in many, especially marly localities; so also the Ground-pea (so valuable for its oily seeds), the Bersin-clover, and others. Conflagrations of the bush can be effectually arrested, if cultural spots are lined by Opuntias (on which again Cochineal may be reared), or by Agaves from which the Pita-fibre, and by Phormium from which the New Zealand flax is obtained, these plants neither being inflammable nor likely to perish altogether when they are scorched. White Mulberry-trees admit of being trimmed into hedges, and would thus conveniently afford food for silkworms on any farm, wherever needed or desired. The Adeira Arrowroot of Peru (Canna edulis) would grow vigorously down to the most southern portions of the colony, in almost any soil of trifling fertility.

Wherever waste sands are likely to encroach the dissemination of native maritime bushes can be powerfully aided by the incomparable Sandstay-shrub (Leptospermum laevigatum) of South-East Australia, and by establishing the famous Moram Bent-grass (Psamma arenaria), and the tall Sea Lyme-grass (Elymus arenarius), both of which tall widely-creeping grasses (through the instrumentality of the writer) have found a permanent home already on the drift-sands of the Victorian shores. Cynodon and Stenotaphrum are here also of immense value for fixing the moving sand-waves. In California large kinds of Lupins are preferentially chosen for the same purpose, while the annual yellow Lupin (Lupinus luteus) is the best for raising the first fodder-crop or green manure on sand-lands, where the absence of lime forbids the culture of Sainfoin and many other fodder-herbs. One of the best native tanners' Acacias of West Australia, A. saligna, with the eastern A. pycnantha, will arise, if properly sown in the autumn, from even seacoast- and desert-land. I should like to see the annual Peruvian Sunflower naturalised on any forlorn spot for the sake of its oily fodder-seeds.

Many waters, whether stagnant or fluent, whether in or out of the forests, can contribute their share to the economic resources of the colony by being made the vehicles of particular alimentary plants. Let us only be reminded of the Trapa Water-nuts, the North American Zizania grasses (Z. aquatica and Z. miliacea), the Kausun, another Zizania (Z. latifolia) from China, which yields a culinary vegetable, and the Solah-pith plant (Æschynomene aspera). How far south the two Nelumbos of Asia and North America will endure the clime remains yet to be ascertained; but they have been traced to the 44th degree in the northern hemisphere. Nelumbo nucifera is with real Rice indigenous in the waters of Arnhem's Land, and both are probably natives also of the West Australian northern territory. Further information on prominent utilitarian vegetation is offered in the "Select Plants," in which work all industrial species are also classed for easy reference according to the locality inhabited by them.

C. *The tropical littoral tracts* of West Australia provide ample areas for most plants of the equinoctial zones, although the humid coast-valleys do not perhaps extend very far inland, and soon merge into the drier open regions of the wide interior. The geologic formation of the northern regions of Western Australia remain almost unknown, indeed that portion of the territory to a great extent geographically unexplored; hence the limits of the trap-formation and of the rich alluvial deposits, which would yield the most fertile fields in sheltered positions for tropical products, continue unascertained. The natural boundaries of culture plants in intra-tropical and sub-tropical regions is also not always strictly defined by degrees of latitude, indeed their geographic circumscriptions depend often on a multitude of circumstances, climatic, topographical, and geological. Thus, cotton-culture advances elsewhere from the tropics to fully 36° S. latitude; Bananas ripen under shelter of limestone cliffs as far south as Swan River at 32° S.; Mangos perfect their fruit beyond the tropics in the Himalayas, even up to 3500 feet; Coffee culture continues prolific at temperate elevations of 4500 feet in Ceylon, so long as the large annual rain precipitation, needful for the luxuriant growth of this highly useful plant, is obtained; the Breadfruit-tree stretches in the Sandwich Islands almost beyond the tropics, while its congener, the Jack-tree, advances on mountains in India to elevations of fully 4000 feet, and has borne the clime of Sydney, where also, in 34° S., the Durian-tree became acclimatised. The culture of Sugar-cane, which extends to the countries bordering the Mediterranean Sea, is still profitable at 32° N. in America, and succeeds in the northern parts of New South Wales. The Persea- or Alligator-pear has for a long period been naturalised as far north as the Azores, while the Cassava or Tapioca-plant advances southward to Uruguay; Taro is hardy even somewhat further south; some of the best Dioscorea-yams can be cultivated successfully in the northern portion of New Zealand; the Palmyra-palm yields its enormous masses of sugar even in Persia, a country completely extra-tropical; the best and largest of all Bananas, the Peesangs (Musa simiarum), which has never been introduced into Australia, is also likely to bear the climate very far south.

This may suffice to show that the southern limits of tropical culture, whether of forest-trees or any other plants in Western Australia will very much fluctuate under different meridians and parallels, and according to the particular endurance of any species. What timber-trees should be added to the Eucalypts and the few other large trees with superior wood, indigenous to North-West Australia, must become an object of experiment in many places, as colonisation proceeds northward and inland. It is, however, quite likely that some of the Eucalypts peculiar to that portion of our continent will prove most valuable for increasing the wood supply by cultural means, particularly in the inland-districts. Indian Red Cedar, Teak, and Sal, the best of Ebony-trees, various Guttapercha-trees, West Indian Mahogany and Cedar (Cedrela odorata), the Copal-trees of different parts of the globe, the South Asiatic Gamboge-trees, the best Central American Caoutchouc-trees of the genera Hevea and Castilloa, and a multitude of other arboreous species yielding dyes, and particularly furniture woods in various tropical countries both of the eastern and the western hemisphere, are more particularly fit for plantations in the humid littoral northern regions. A whole host of Nageia-pines from South Asia, Africa, and tropical America would furnish pine-timber in localities where the firs recommended for the southern districts would no longer prosper; to these could be added several splendid Kauri-pines from Polynesia and India, calculated to replace in warmer zones the coniferæ of the north.

As forest management is nowhere restricted merely to the conservation, multiplication, and best utilisation of timber-trees, though that is its primary object, it will not be out of place here to allude to the Indian Mangostan-tree with its luscious fruit, the Central American Cacao-tree, which produces the chocolate, the Coconut-palm, which an enlightened missionary has recently recommended for permanent beacons on emersed Coral-reefs. If it were an object, the whole of the Palms of the globe, exceeding one thousand species, could by cultural processes be established in different localities of Western Australia; but on this occasion I will only recommend the early introduction into tropical latitudes of the Sago-palms, the Oil-palm of Guinea, the majestic Wax-palm which attains in the Andes a height of 180 feet, the Carnauba or Wax-palm of Brazil, the starch-yielding Oreodoxa of the Antilles, the Ivory-palms of Peru, the wonderful Seychelles-palm before that glorious plant becomes extinct, the Peach-palm of the Amazon River, and the Hyphaene-palm of East Africa; whereas, from among the hardier species may be singled out for the extra-tropic latitudes the Chilian Treacle- or Coquito-palm, the sugar-yielding Caryota-palm of India, the tall Toddy-palm or Palmyra extending westward to Persia, all magnificent objects for scenic effects, all of highly utilitarian importance also, all readily raised from seeds, if such are obtained fresh. Bamboos, so important for their multifarious application, and so easily increased and distributed when once introduced, could in their most majestic forms embellish all the Western Australian landscapes except the most scorched desert-country. In Tenasserim, Bamboos rise to heights of 150 feet with a diameter of fully one foot of their mast-like canes; the great West Indian Arthrostylidiums are nearly as high and columnar. The mighty Dendrocalamus of Pulo-Geum is also of enormous size, while in Java some Gigantochloas grow to a height of 120 feet, with a girth of 22 inches. The Bamboos now already known amount to about 170 species, many of stupendous height and marvellous rapidity of growth, and of these a considerable number can be transferred even to the southernmost limits of Western Australia, as some of the Chusquea Bamboos reach high elevations on the Andes, while several Himalayan Arundinarias advance to nearly the snow-line. It would need a volume to enumerate whatever foreign countries could contribute to the wealth of West Australia, which, so far as cultural capabilities are concerned, excludes from its zones in reality only the Arctic and Alpine vegetable organisms, and which can afford apt space and shelter in select spots also to every Palm in existence. But this Report would become extended to an undue length, and would deviate from its primary intentions, were I to dwell still further on the almost endless forms of plants, particularly from intra-tropical parallels, which the industry and intelligence of the colonists of a great and rising country are sure in the course of time to render their own for the augmented enjoyment and prosperity of coming generations.

IV.—INITIATORY MEASURES SUGGESTED FOR ESTABLISHING FOREST ADMINISTRATION IN WEST AUSTRALIA.

A.—*Local Forest Boards.*

To effect a vigilant surveillance over such wide forest-tracts as those of West Australia, it is suggested that the central-office administration should in the first instance be aided by local Forest Boards, each consisting of a few members chosen for the sake of their experience in wood industries, or for their predilection for cultural pursuits. Such Boards would readily meet once a month, inspect periodically the local forests under their control, would frame such regulations for aiding the central-office as would be best adapted for preserving, increasing, and utilising the woods of their own districts, would lease out forest-lands, sell timber in circumscribed areas, would issue licences to woodmen, direct measures for new cultures, guard against waste, choose means to utilise the collateral products of their forests, and foster or create industries for obtaining potash, charcoal, tar, vinegar, alcohol, dyes, tanners' material, and other products or educts from their local woods. At the commencement it might suffice to station merely one State officer in each district to be the practical functionary of each local Board, to whose directions he should be amenable, while measures of general importance would all remain subject to final Ministerial approval and surveillance. In the first instance, an industrious man, merely of horticultural experience, circumspect intelligence, and of modest aspirations, would locally suffice for giving effect to the earliest resolutions of each Board.

B.—*Revenue from Forest Areas.*

The local Boards should be empowered to raise revenues from the areas entrusted to their care, in order that their decisions on any subject of protection or improvement of the forests should not remain inert for absolute want of monetary means. Wise statesmanship does not expect to raise extensive incomes from forest-lands without re-voting at least a portion of the funds so obtained for renovating, or for enriching to some extent, the very forests which yielded the revenue, not to speak of the occasional or frequent necessity of enlarging or even creating forests, where timber may be scanty or altogether wanting. These two cardinal measures—namely, the appointment of Forest Boards and their endowment with a portion of the forest revenue—were recommended by me long ago as the first steps necessary towards establishing an initiatory forest administration in any new colony, where forestry according to modern European organisation could not possibly be initiated at once, while the population remained scanty, and the income of the colony very limited, in comparison to that of densely populated older States. The adoption of these two primary measures I advocated for many years for all parts of Australia, and set them fully forth in a lecture on "Forest Culture in Relation to Industrial Pursuits," copies of which in 1871 were widely circulated, and reproduced also in America. In this lecture I explained also at length the importance of maintaining forests on climatic and hygienic considerations, and for the sake of controlling and regulating to a large extent the water-supply and its distribution over any country. This lecture might deserve, perhaps, re-issue in West Australia.

C.—*Survey and Reservation of Forest Areas.*

It is important that in any country, even where private enterprise fosters forest-culture, extensive areas of woodland should not be encroached upon, but be retained by the State, to place the final alienation of all forests from Government beyond possibility. Such reserved and carefully surveyed areas would best remain unbroken, and therefore private settlement should be excluded from them. Wherever possible natural boundaries, especially those afforded by watercourses, should be secured. This foresight ought to leave to the State the control over many of the principal sources of rivers, and would enable the forest department to seize at any time on any such wooded Crown-land needed for cultures—whether of trees or any other plants—as could not exist or would not prosper outside of forest-regions. Such reserved woodland might, under due restrictions, be leased out by Forest Boards to pastoral tenants, to obtain a revenue without injury to forest-interests, and leaving it optional for the State to resume full possession of the woods whenever cultural or technical operations in the area became expedient there.

D.—*Disposal of Timber, Fuel, and other Forest Products.*

The necessity of surveillance over the existing timber-resources of the State in order to prevent waste, and to encourage, regulate, and protect the natural upgrowth of young trees, cannot be too rigorously insisted on; furthermore, it must be the object of an enlightened forest administration to frame and enforce rules, according to which timber of the best quality should be cut at that season when the circulation of the sap is least active, in order that, for the credit of the timber-resources of the colony, wood only of the best kind obtainable may come into the trade. The renovation of superior timber in the Eucalyptus forests can also greatly be aided by timely removing saplings, where they have arisen too copiously for the proper final development of well-formed trees, and by filling up empty spaces, through sowing or planting operations, with the view of deriving the greatest possible return from the whole forest area. Arrangements for the earliest renewal of the forest, wherever denuded by the removal of timber, devolves also on a regularly-established forest administration;

moreover, in West Australia the very important question must arise whether the removed trees are to be replaced by native species of the same kind, or whether to some extent trees of foreign countries should be sown or planted. In the latter case, it involves much consideration and inquiry to choose for each climatic region, and for each geologic formation, those particular species best adapted for the respective localities; and in this respect many indications, given in my work on "Select Plants," will to some extent prove available for guidance. As elsewhere, so also in West Australia, one of the leading considerations for forestry will be to decide on the systems of removal of timber, whether by the total sale of all the wood on defined square miles, or by numbers of trees within surveyed areas, whether by restricted licences or by any other well-meditated mode. In all such measures the local Forest Boards could afford the best advice to the central administration.

E.—*Importation of Seeds and Plants.*

The mode of adding to the natural constituents of a forest from abroad may be twofold; either by interchanges or by direct purchases of the plants or seeds desirable for any forest locality. Importations by purchase of seeds tend on the whole to the speediest and most extensive enrichment of forests, although the treasures of woodlands can be largely augmented also by sending abroad seeds of native plants, to secure in reciprocity those eligible in other countries, whereby, moreover, the resources of the colony become thus far widely and instructively known. The least expensive and the simplest mode of obtaining seeds in quantity, from which vast additions to forests can be realised far more cheaply and speedily than from the introduction of living plants, is always by simple mercantile trade. Orders for seeds might, however, be brought under the control of consular officers, directors of scientific gardens or other competent authorities, to secure by their aid the selection of the right kinds and of fresh and well-matured seeds, and also a careful system of packing and despatch. West Australia is singularly fortunate in being able to initiate an extensively ramified system of interchanges in seeds, as, indeed, very few countries in either hemisphere can vie with the western colony of Australia in the numeric richness and the elegance of its exclusively endemic forms of plants. The Geographic Index appended to my work on "Select Plants" would afford aid in ordering from any part of the globe seeds of such plants as would prove hardy in South-West Australia for either forest-culture or agronomic purposes.

F.—*Establishment of Local Nurseries.*

Both for immediate extensive supplies of trees of recognised value and for plants intended merely for experimental tests, local nurseries in the forests themselves need to be established, the transfer of living plants on a large scale from one locality to another being beset with difficulties, subject to great losses, and involving proportionately large expense. For forest purposes, it is not sufficient to plant a limited number of trees; if practical results are to be attained trees must be raised by hundreds of thousands. Rarer kinds, or such as are apt to succumb in their earliest stage of growth, are, as a rule (subject to some exceptions), best planted out at defined distances as seedlings from nursery-beds, whereas the seeds of commoner and hardier kinds of trees can be scattered best (after some cheap preparation of the soil) at once in suitable spots of the forest, particularly at the end of the hot season. Forest-nurseries serve simultaneously for raising many kinds of plants besides forest-trees, but fitted only for a forest clime, to obtain from them a remunerative additional yield of the woodlands. From forest-nurseries plants can be distributed to a limited extent for tests in various localities with different soil and clime. When a local trade in any important plant has sprung up, the opportunity often arises for forest administrators to secure at a nominal price the surplus of plants or seeds, after private estates are supplied, for the State forests.

G.—*Test Plantations.*

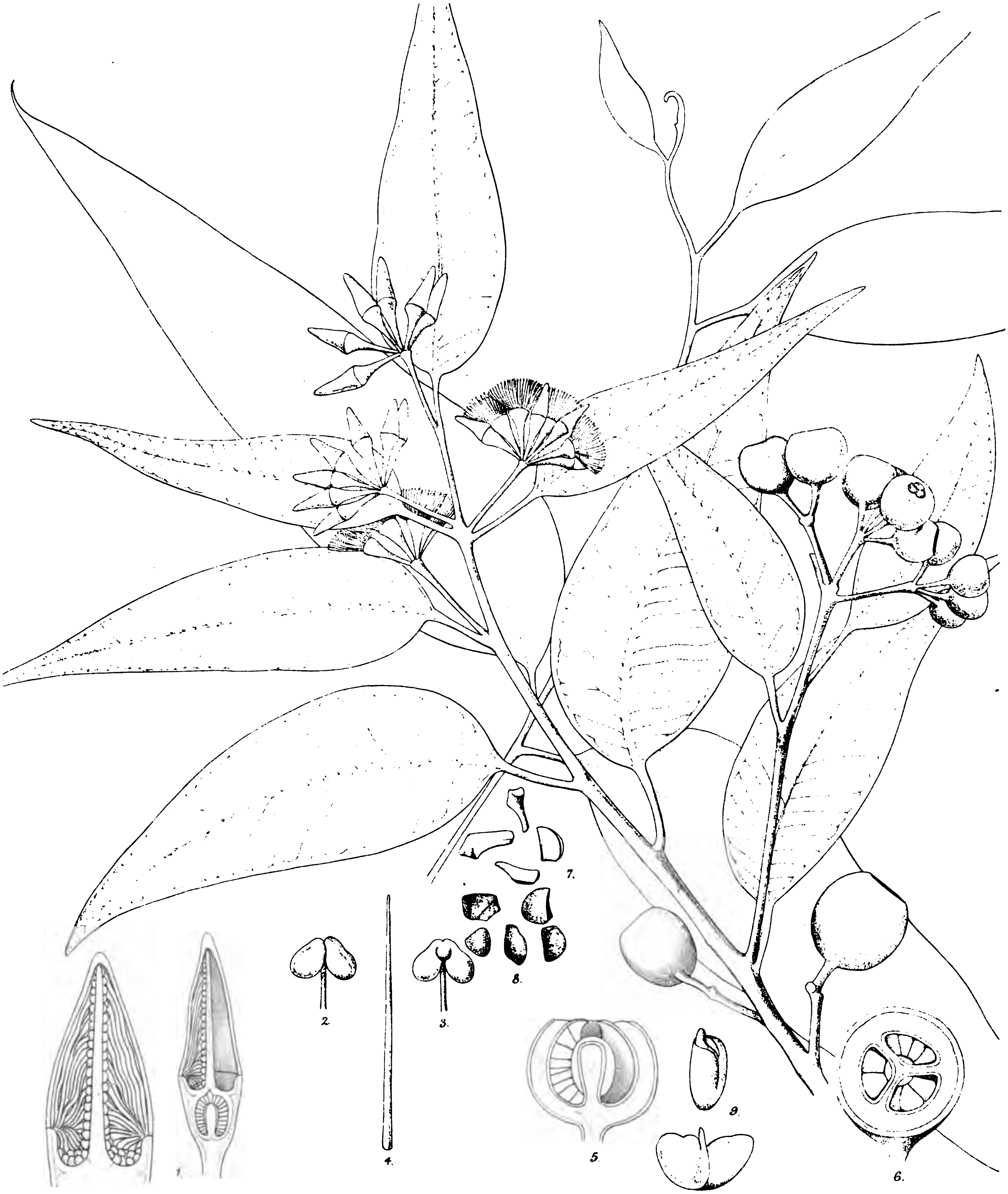
Irrespective of the local nurseries under the supervision of each Forest Board (to the formation of which was alluded already), it would be advisable to create three general experimental plantations, one in each of the principal climatic regions of the West Australian colonial territory. At the commencement it would suffice to station, as an operator on each of these three plantations, only one person, who should combine zeal and circumspectness with plain horticultural ability. A series of tests could then be initiated and annually recorded, to guide settlers in the selection of particular plants for their gardens, farms, pastures, or forests. These experiments would indicate also to which trees preference should be given in each of the main climatic regions before the more expensive and toilsome process of rearing foreign species in masses comes into operation. Thus, also, an endless array of fodder-herbs and grasses could be tested, which naturally are of such very scanty occurrence in most of the districts of Western Australia, while of long introduced culture-plants, such as, for instance, the Tobacco, the distinct qualities arising in different latitudes and on various soils could readily be made known. Moreover, the Tobacco-plant delights in rich forest-soil, particularly where limestone prevails, on account of the potash combinations which abound in woodland soil, and also as in the clearings of forests the atmospheric humidity prevails which is needful for the finest kinds of Tobacco. At such centres of cultural experiments, sustainable at a very modest expenditure, means for irrigation should be within reach for increasing the scope of the experimental inquiries. On providing for the two cardinal requirements of West Australia will to a large extent depend the increased future prosperity of the colony—namely, on the *augmentation of the water supply*—either by mere storage, or by the more costly but in time largely remunerative process of Artesian borings—and on the *copious dispersion of perennial grasses and fodder-herbs* best adapted for each zone, and which by their gradual spread will add unceasingly to the country's wealth.

Though the intra-tropic portion of West Australia is only under incipient settlement, it would be a wise measure to commence early test-cultivation of tropical plants also at Nichol Bay. The small outlay involved will be a thousandfold regained in periods not distant. Test-gardens further north could be formed as gradually colonisation proceeds in that direction. Almost a countless number of plants of industrial and pastoral importance could be reared in the tropical latitudes of West Australia, many or most of which would not thrive further south. Again, it will be found that the coast-country towards Arnhem's Land belongs to the zone of the Spice-plants and general equinoctial vegetation, while the drier inland regions, in which the temperature sinks very low during the nights of the cool season, will prove more adapted to sub-tropic plants. The limits of these zones of vegetation can best be ascertained by practical tests, such as could be extended by distributions of plants from a few original plantations on the coast.

H.—*The Creation of a Museum of Vegetable Products.*

A powerful and very demonstrative auxiliary for diffusing knowledge on forest-trees, and indeed on any other utilitarian plants, is afforded by an economic and technologic Museum. Such may be made an adjunct to a general Museum, or be maintained as a separate establishment, according to local circumstances. In either case such an institution need not be burdensome by claiming costly endowments; but, whenever possible, it ought to be connected with a real Botanic Garden, in which under scientific direction the various plants important to trade, factories, dispensaries, workshops, and households are cultivated, and geographically, systematically, and technologically grouped, so as to be readily accessible for information, with the least sacrifice of time. The timber of various parts of the globe, together with other forest-products, would necessarily be included among the subjects prominently displayed in such a Museum. Much can be accomplished by inexpensive methods in this direction under judicious and experienced management.

In concluding this general Report on the forest capabilities of Western Australia, I am conscious that many important questions bearing on the subject under consideration have remained unanswered, while other points have been insufficiently discussed. But within the limits of one preliminary document the multifarious aspects of the forest-interests of a vast country, with territorial possessions both in the temperate and the hot zone, could not be exhaustively scrutinised, even if more extensive opportunities for research had arisen to the writer. It will, however, be to him a pleasing task to aid further in the development of the great resources of West Australia, as he may fairly claim to have done to some small extent during the last quarter of a century, and he can foresee that before another generation has passed away, the whole of the immense extent of that great country will be densely occupied by settlements, and will under its winterless sky afford happy abodes and scope for innumerable industries to many millions of prosperous inhabitants.



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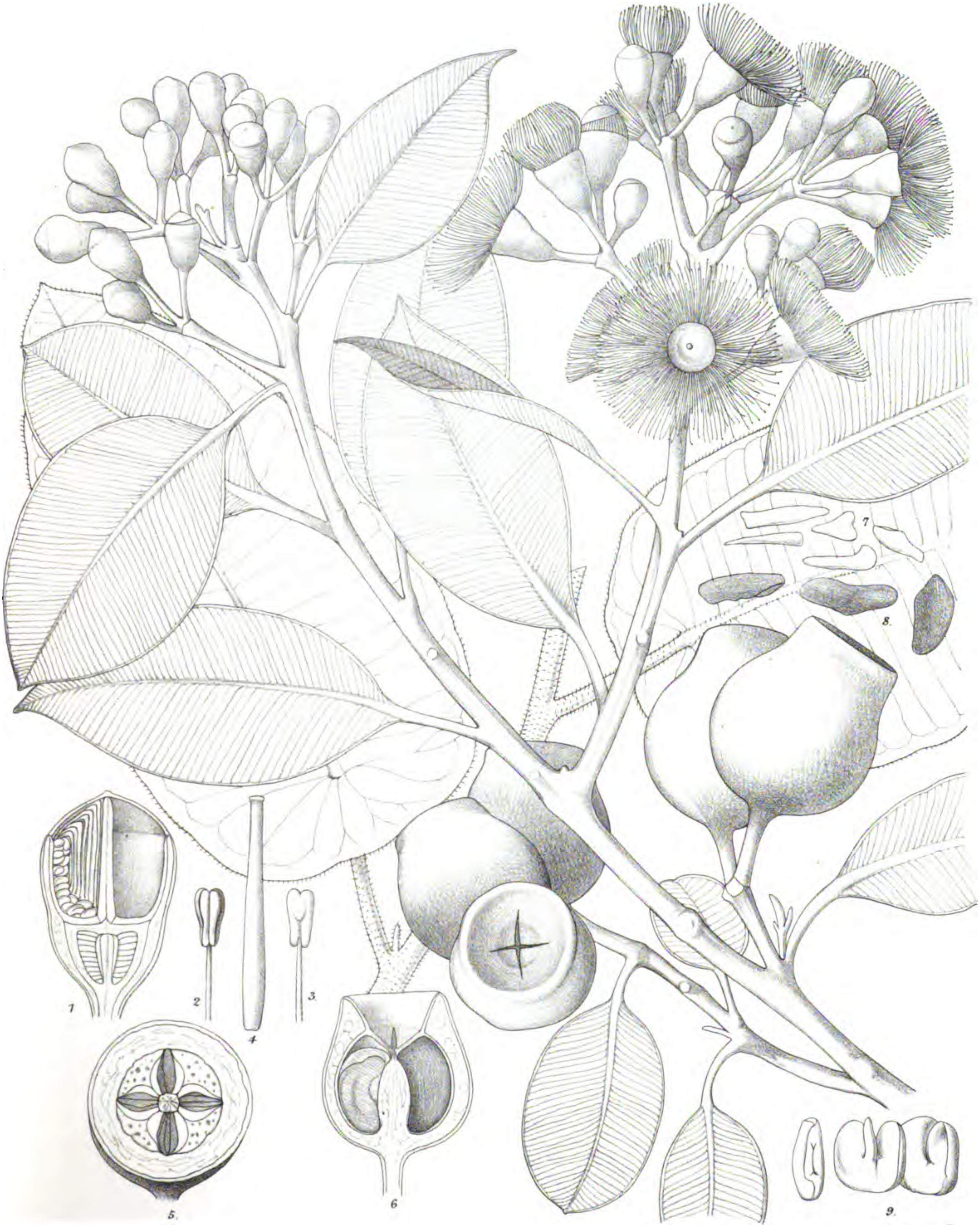

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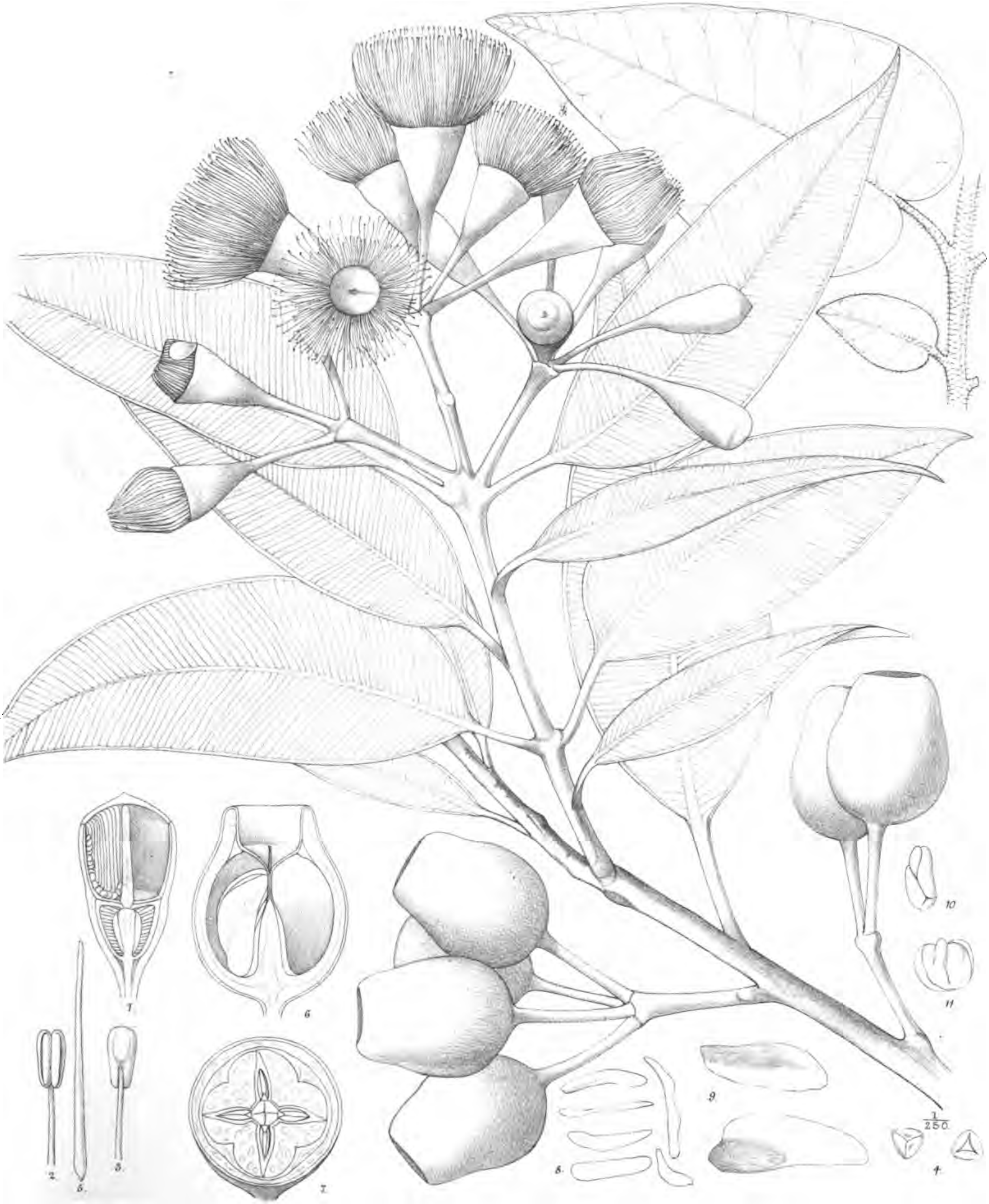

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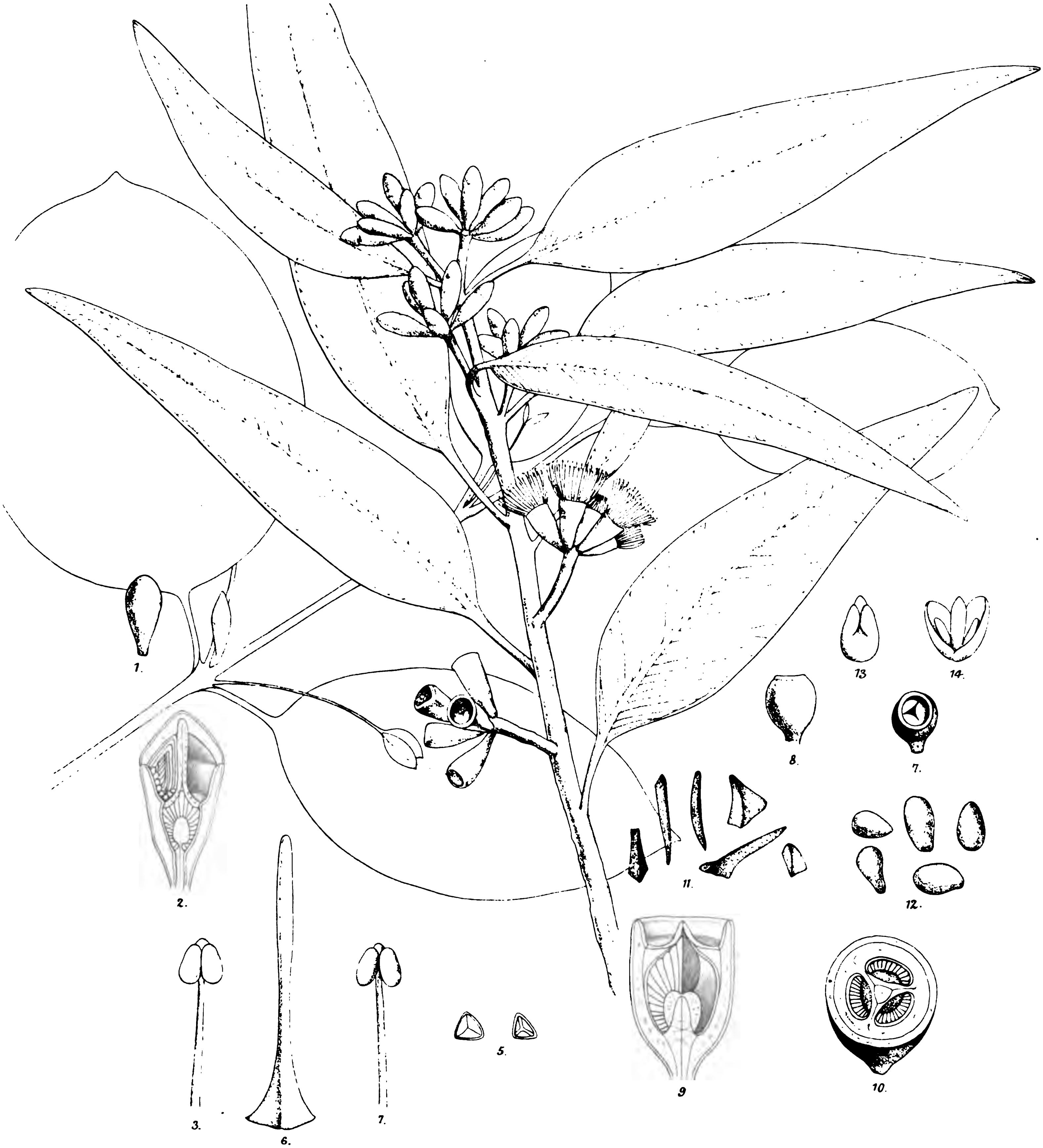

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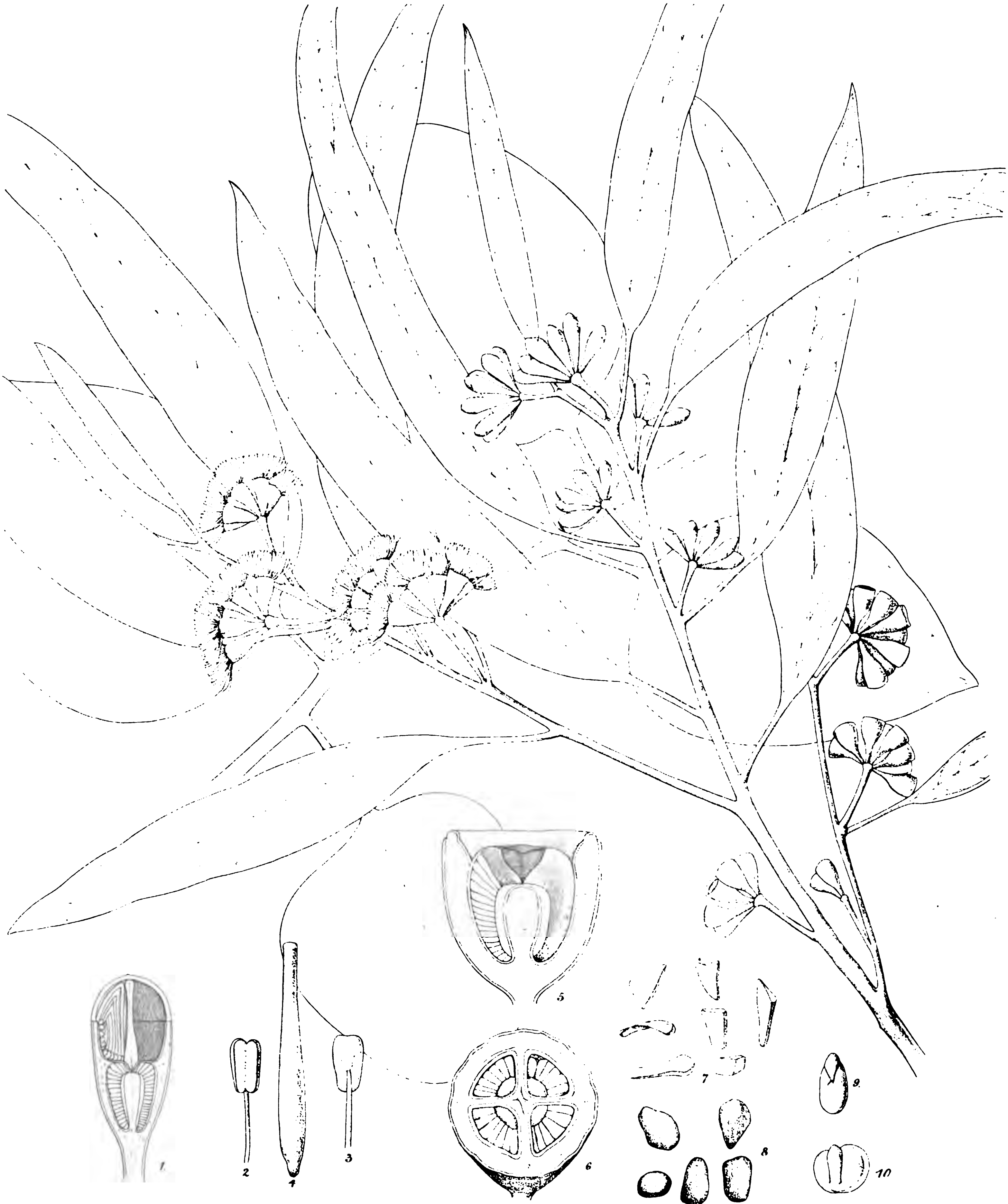

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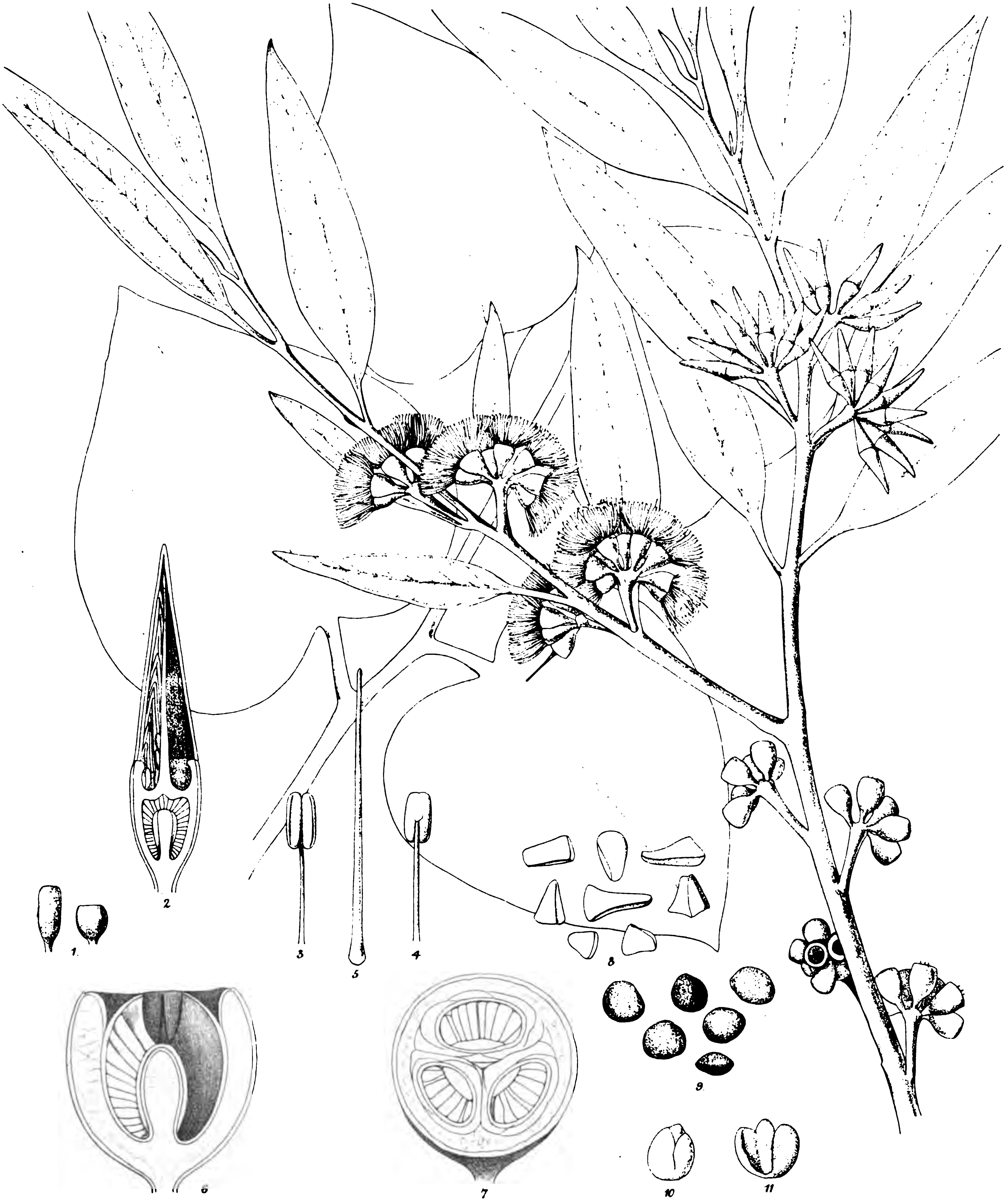

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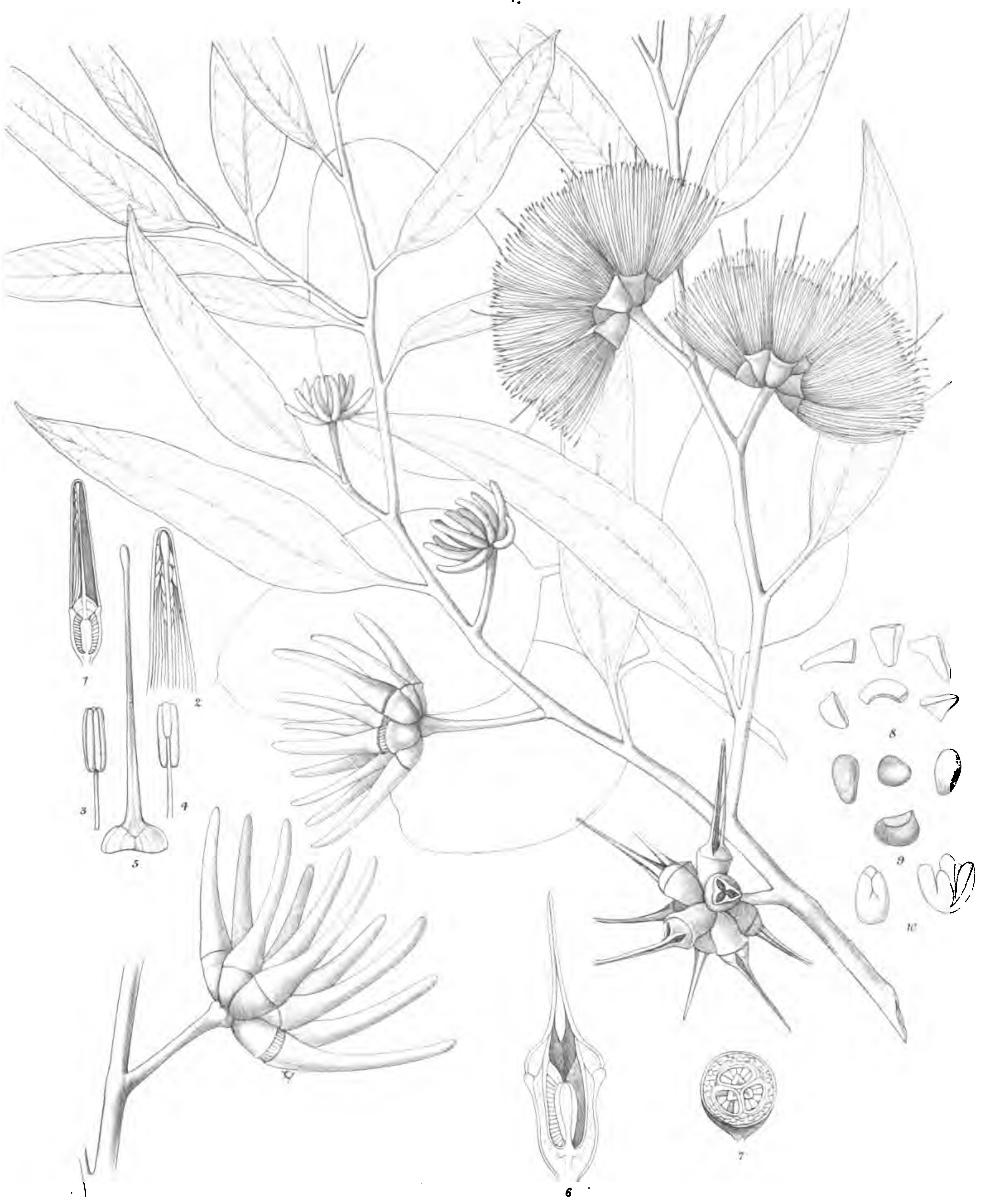

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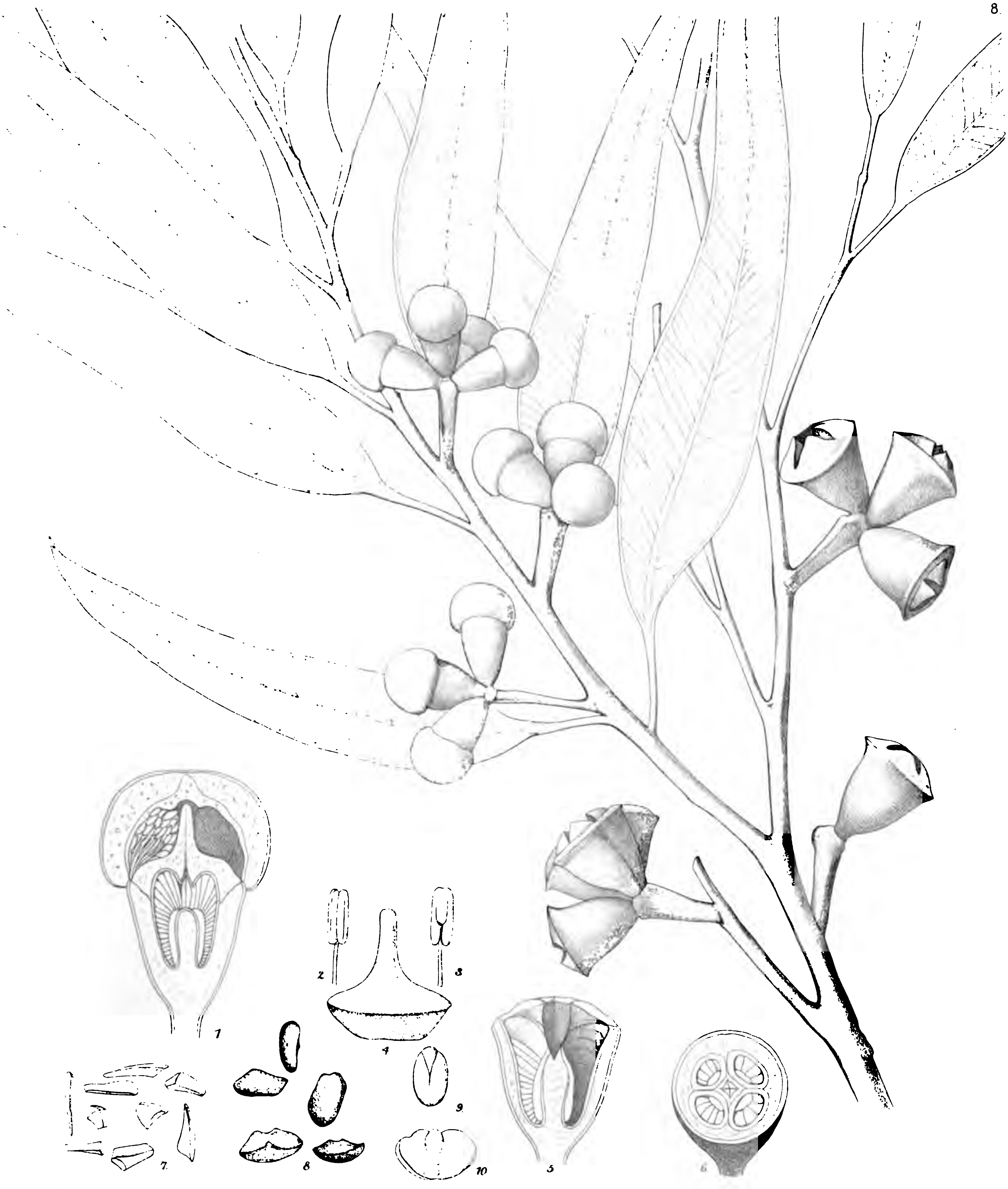

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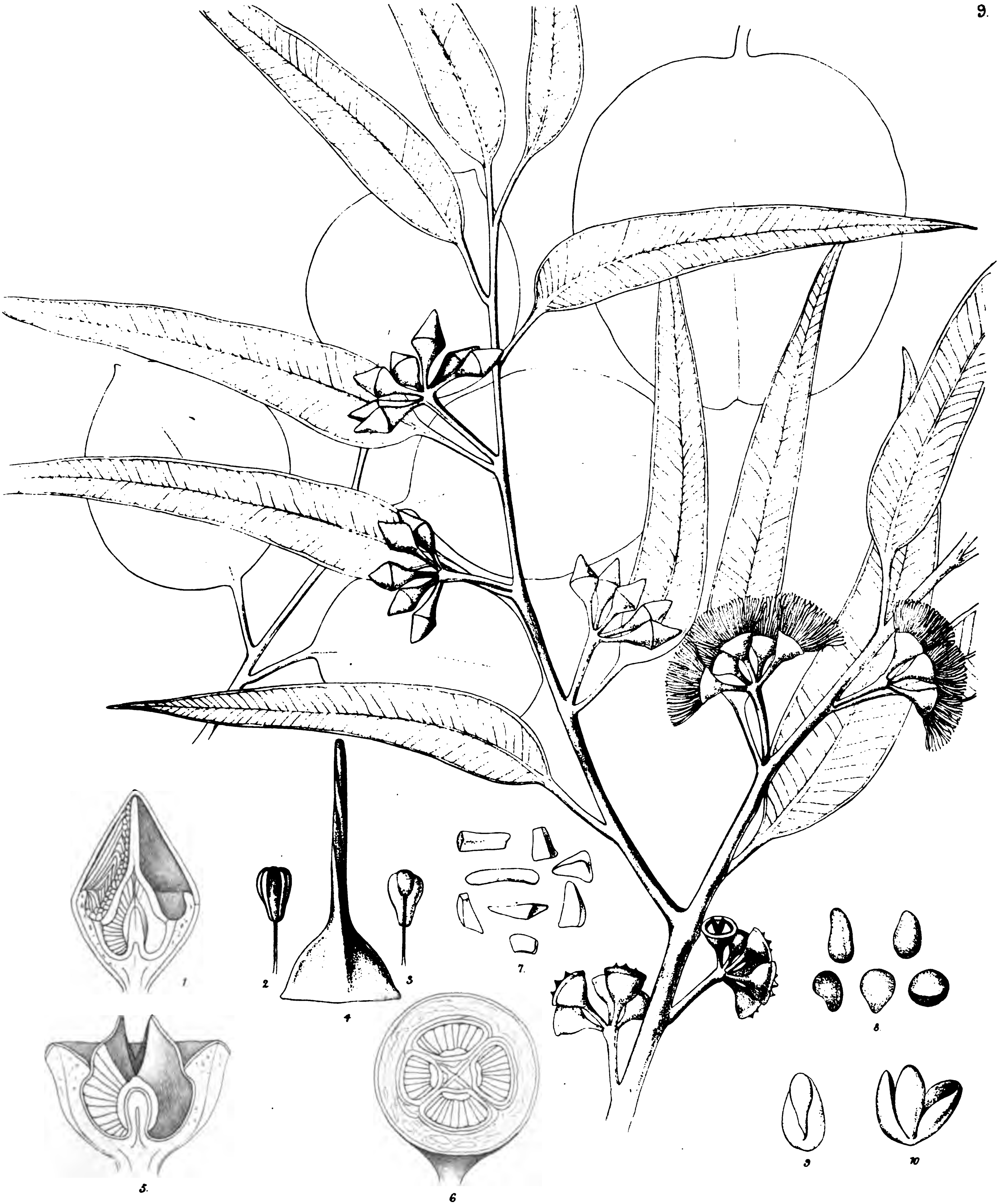

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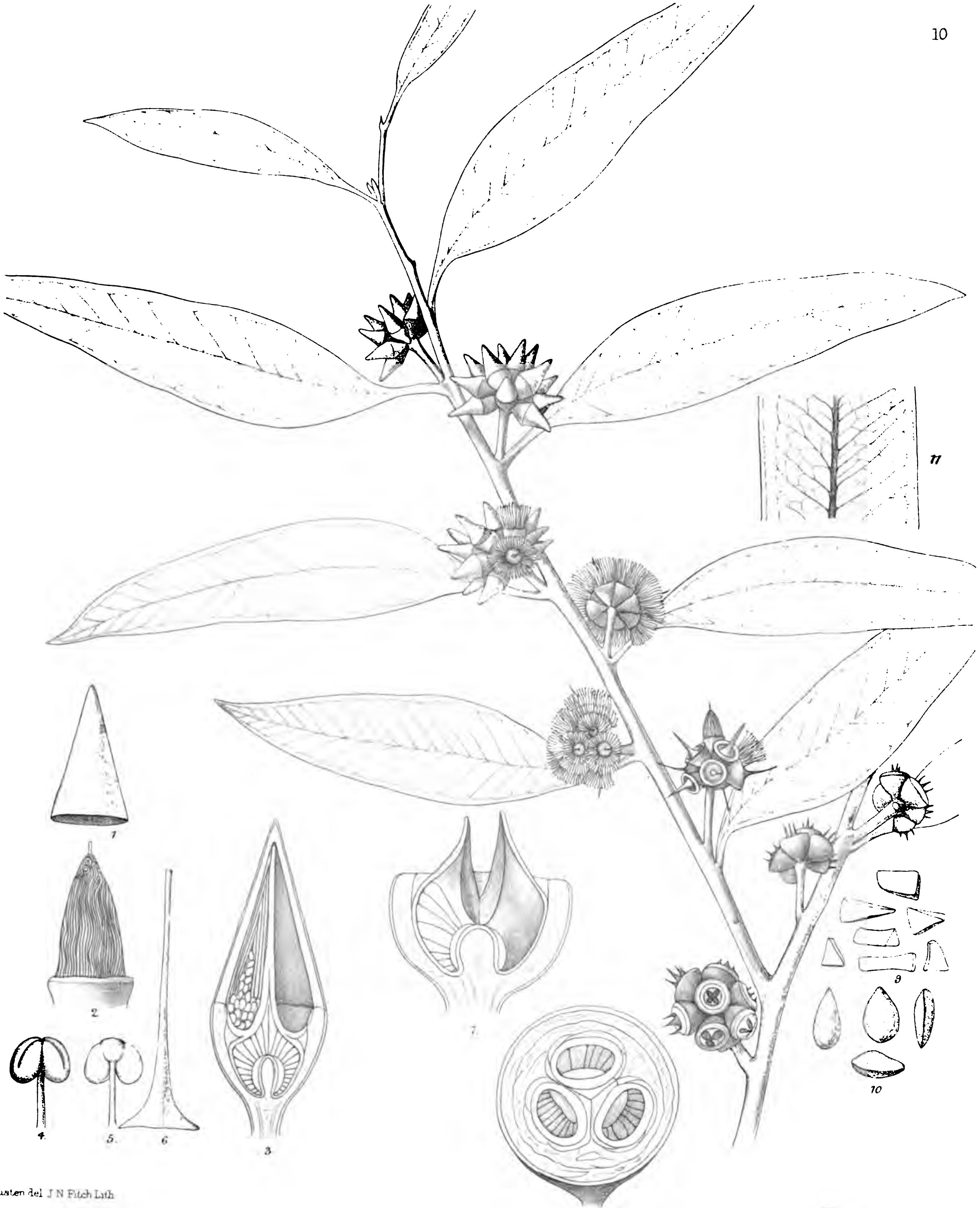

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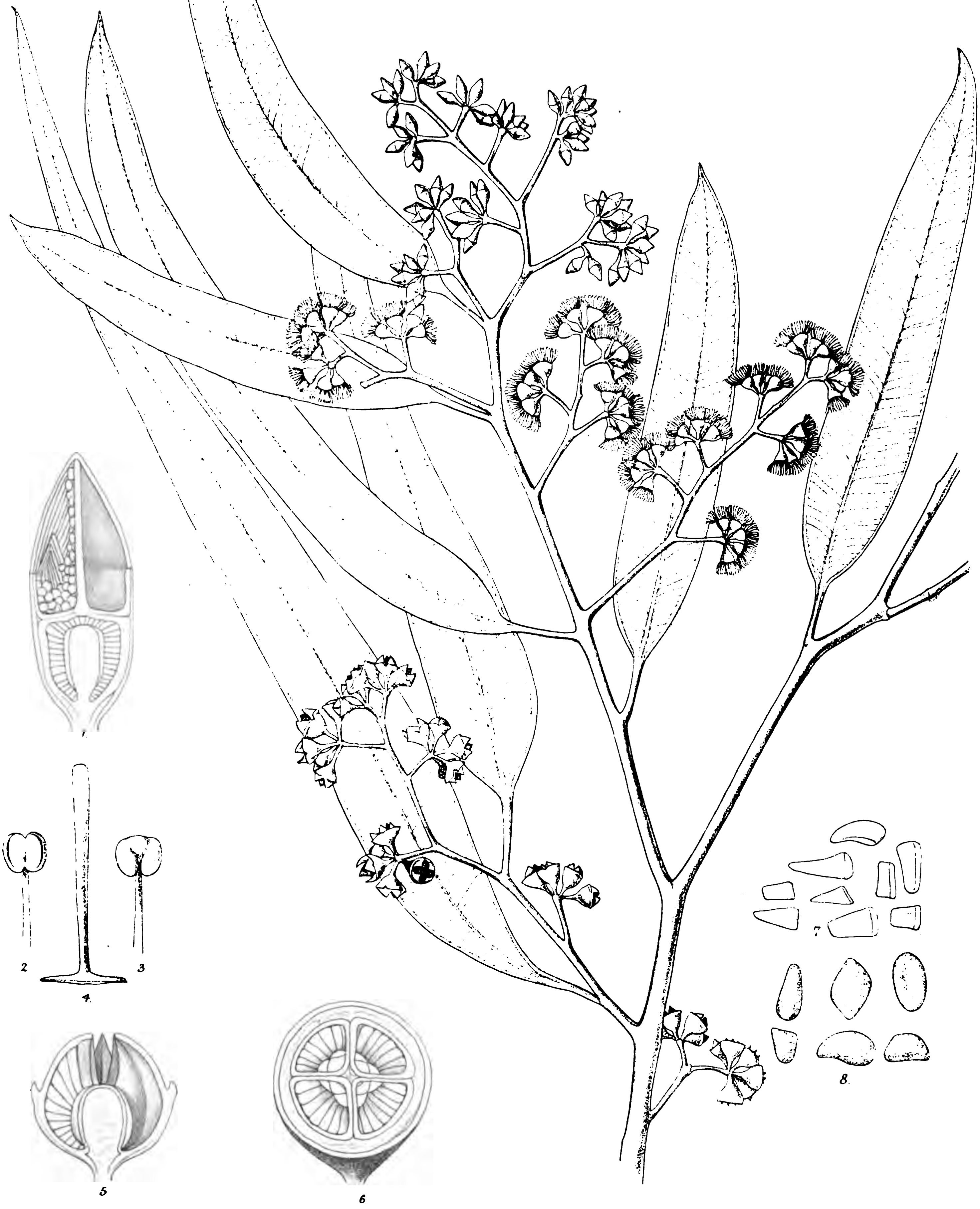

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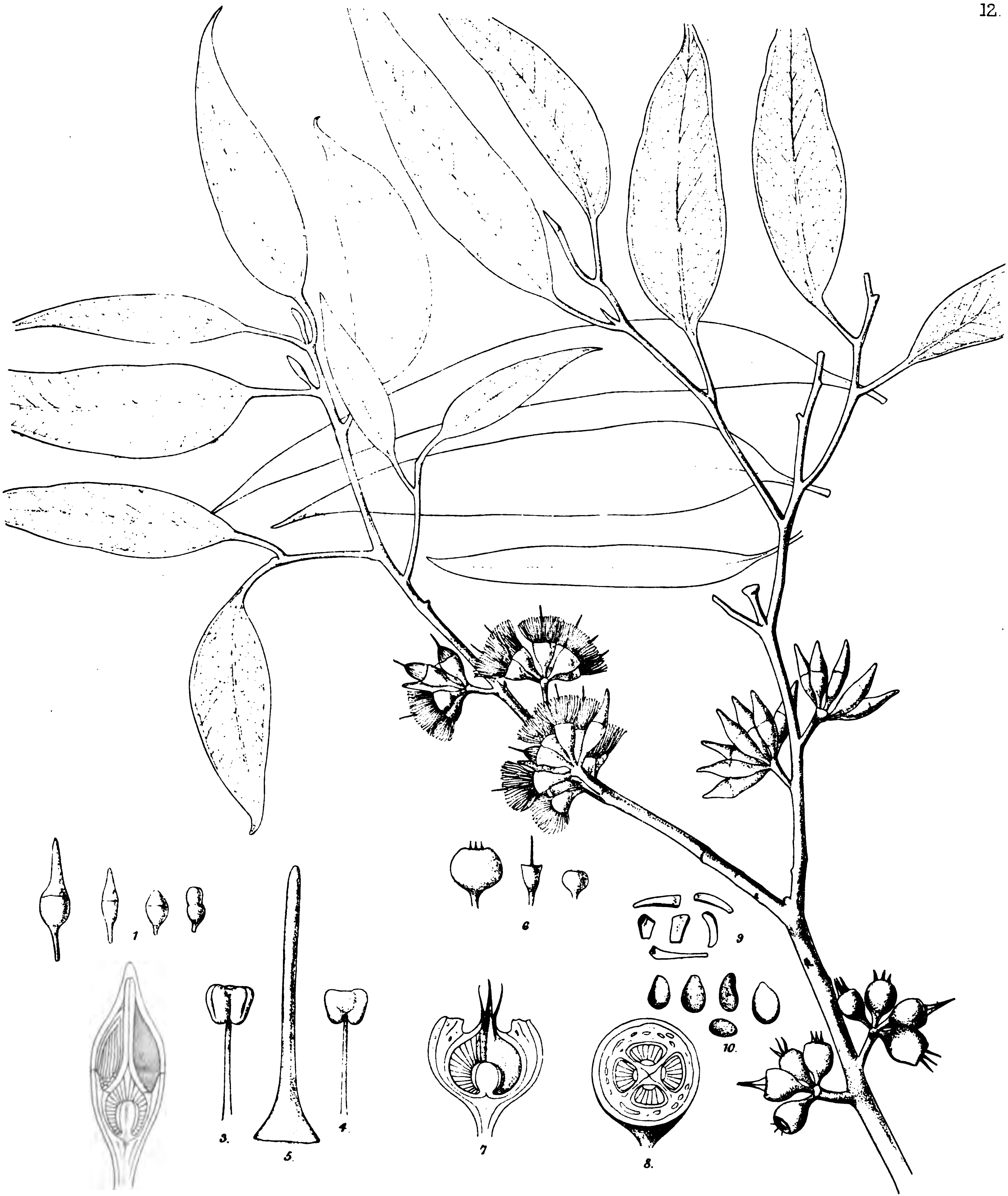

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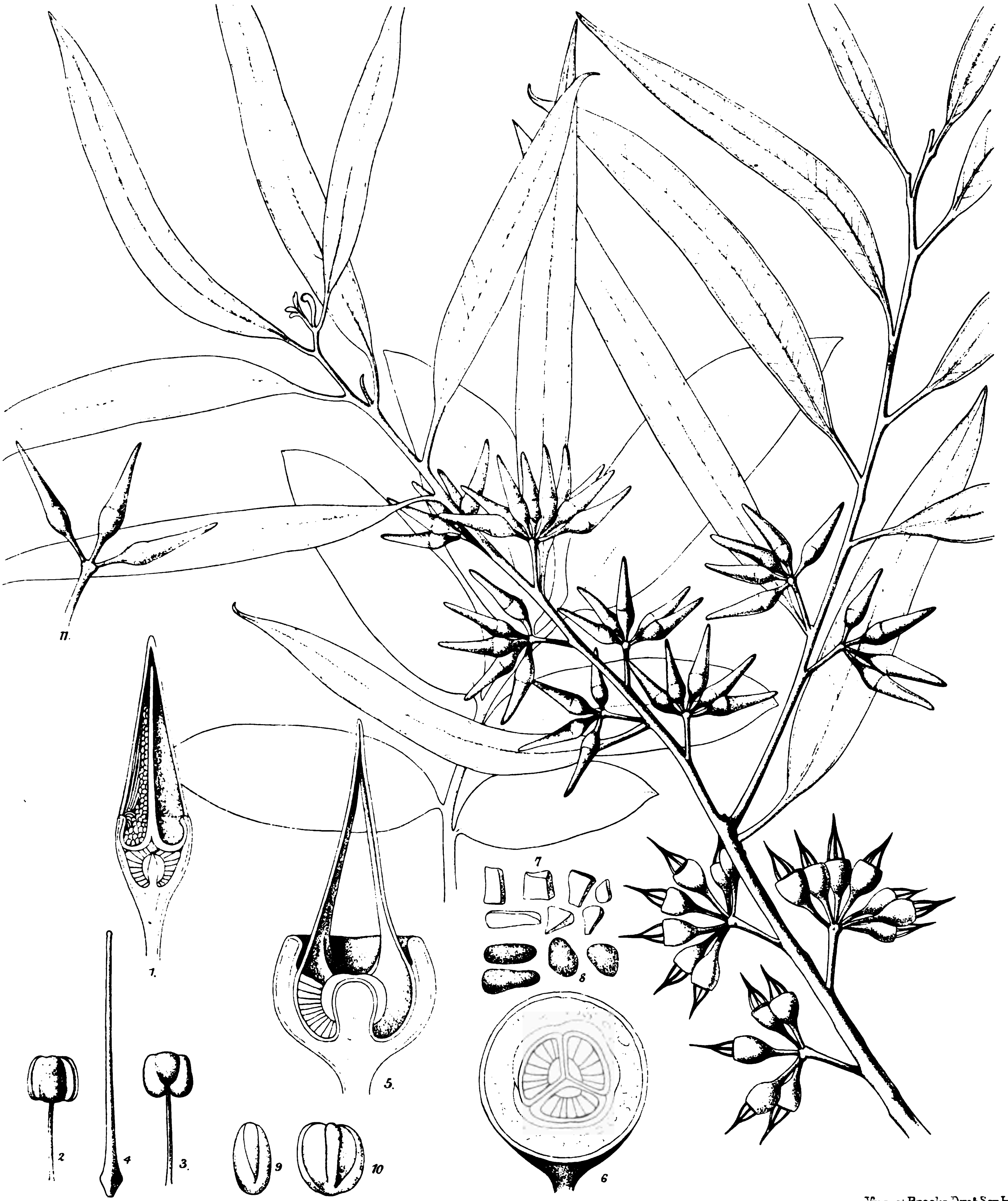

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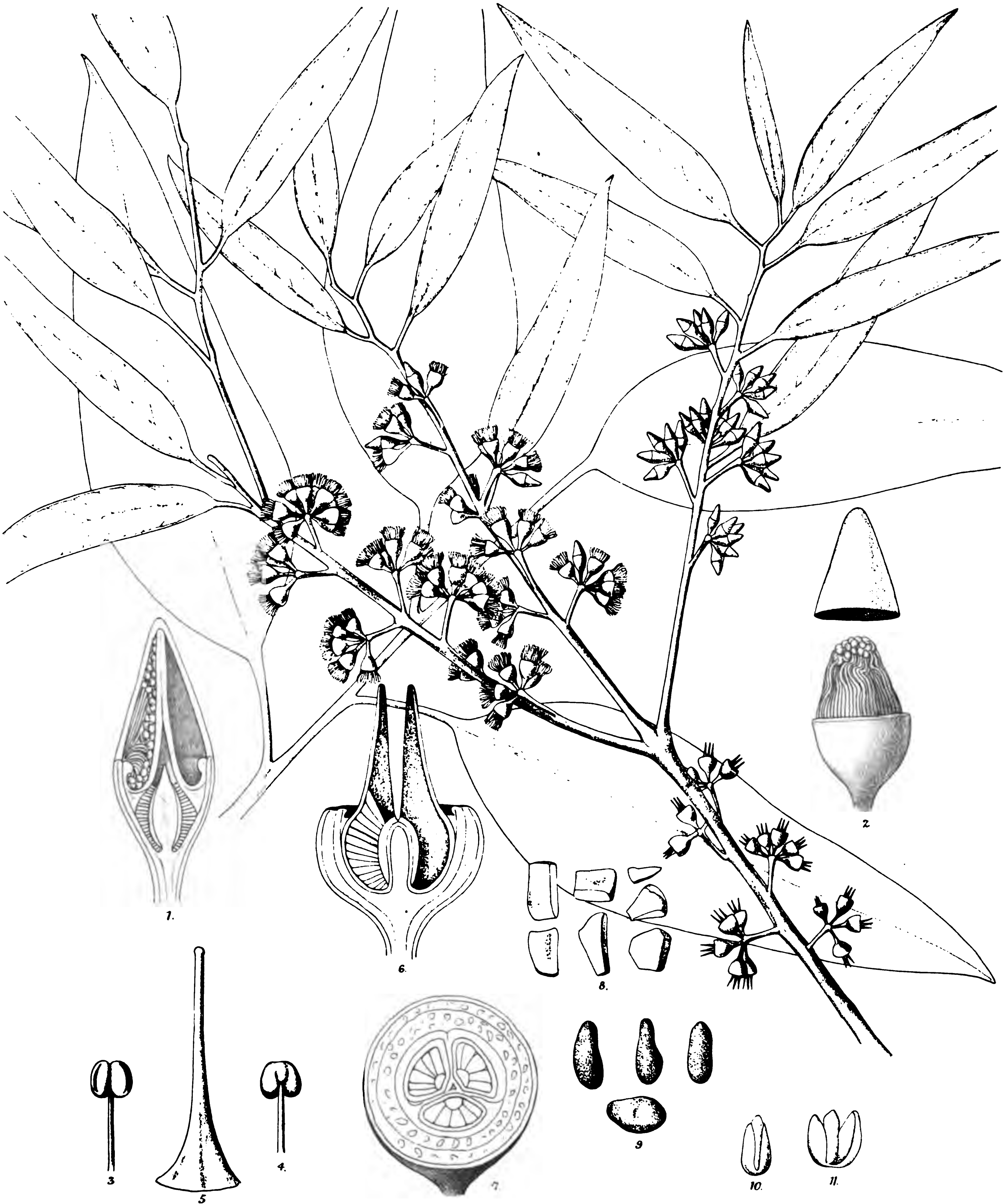

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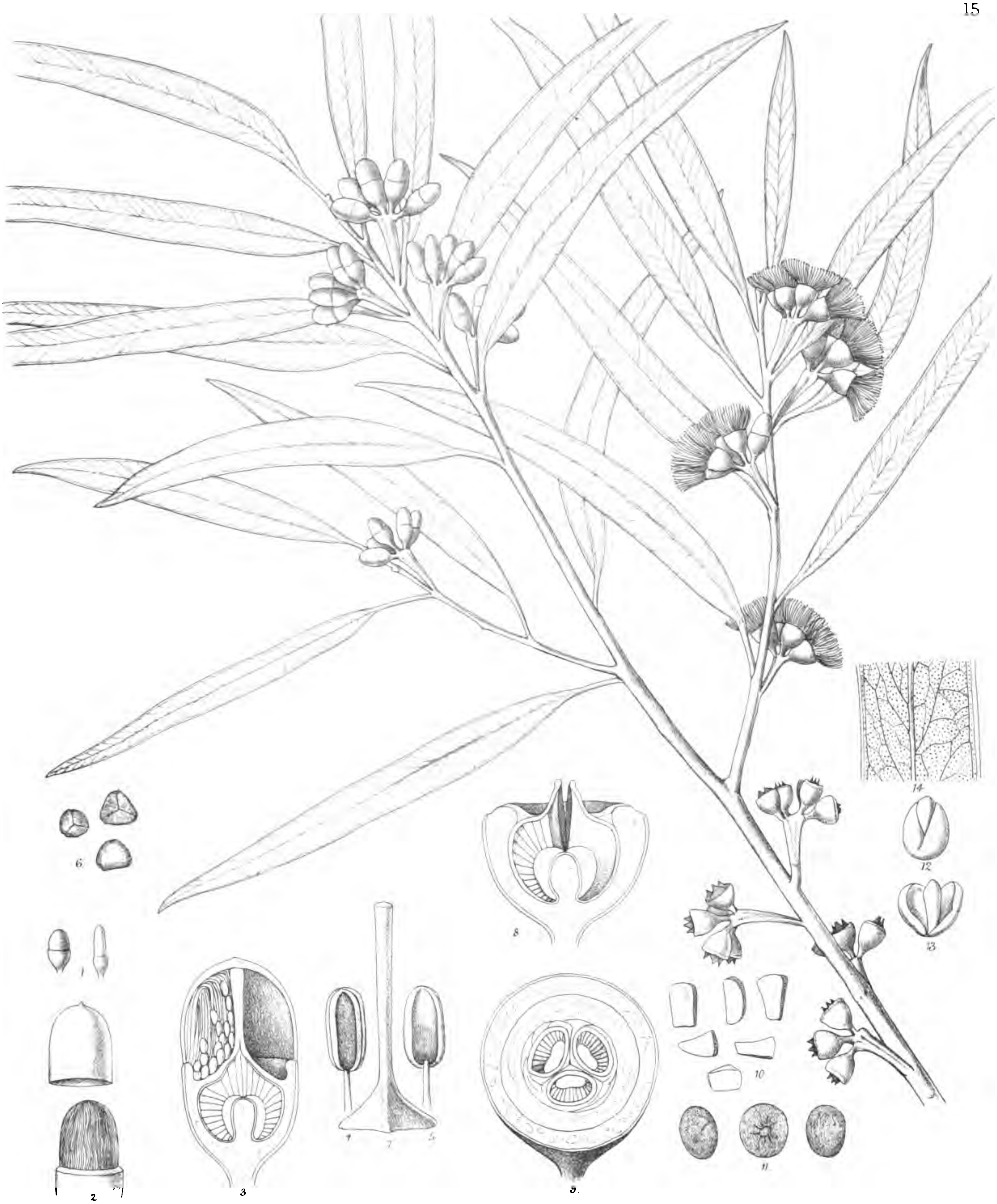

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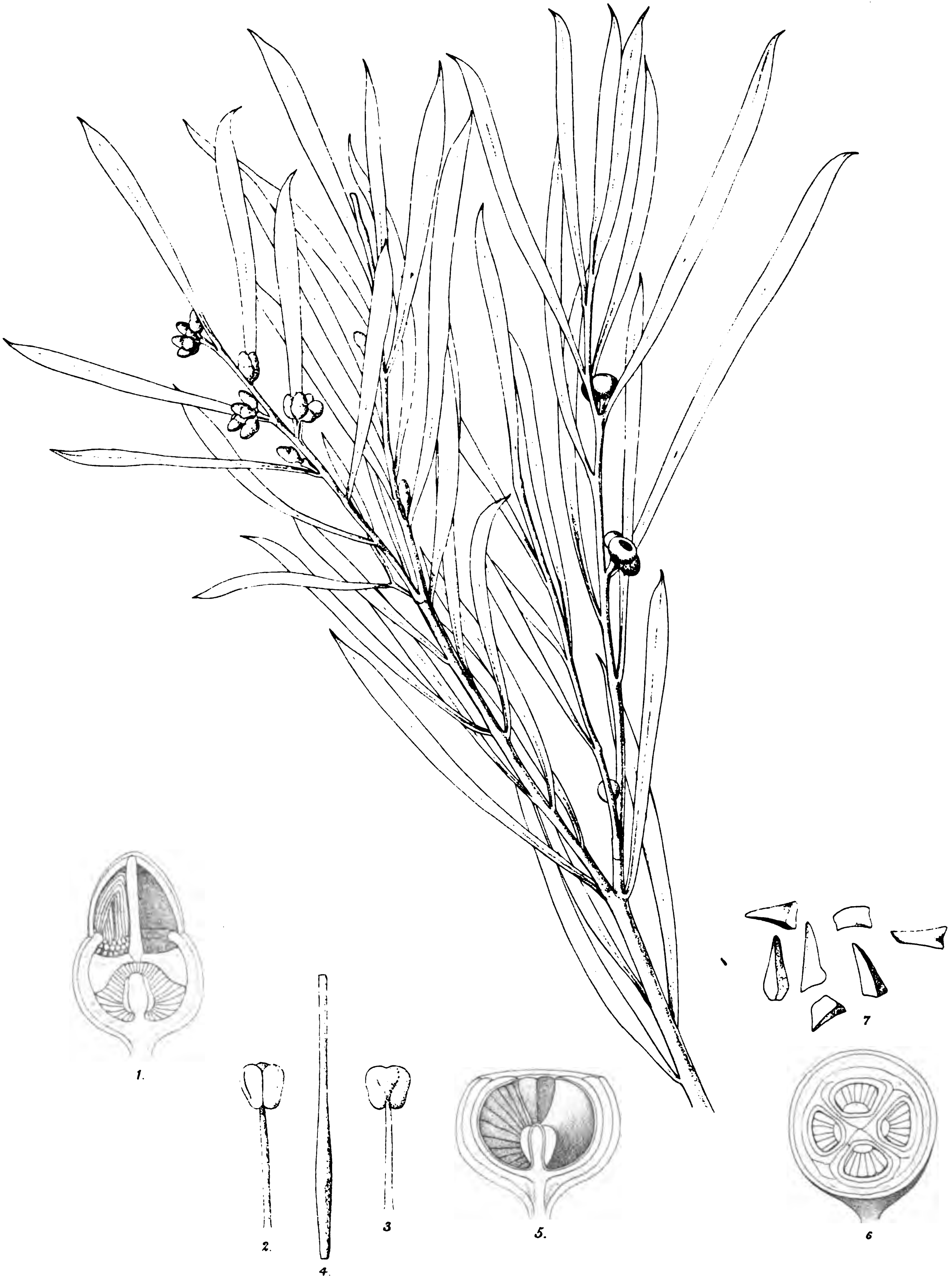

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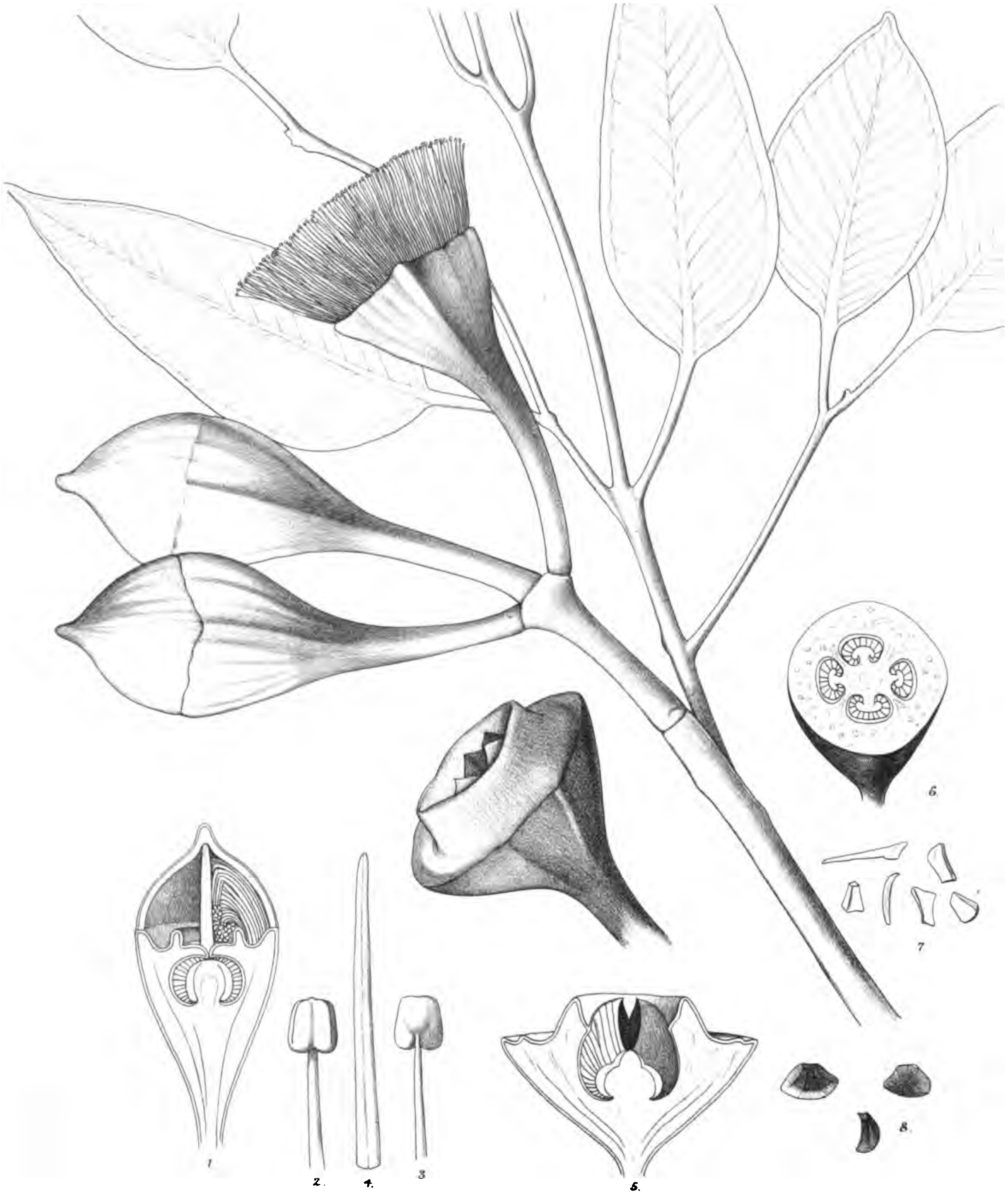

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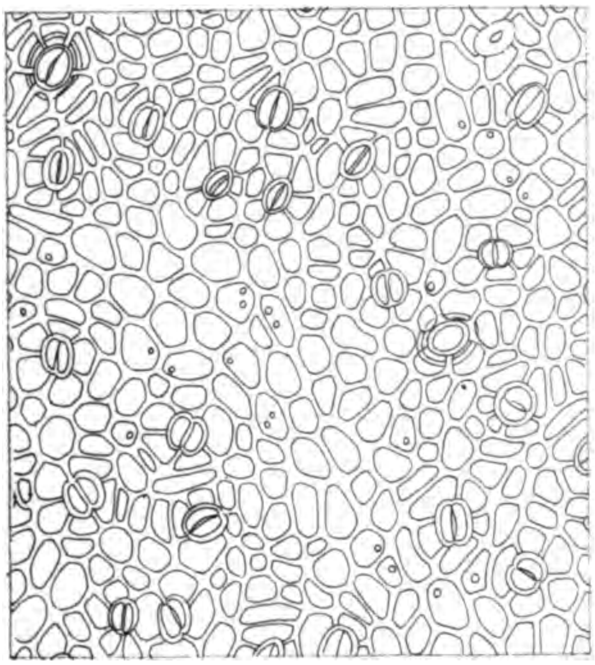

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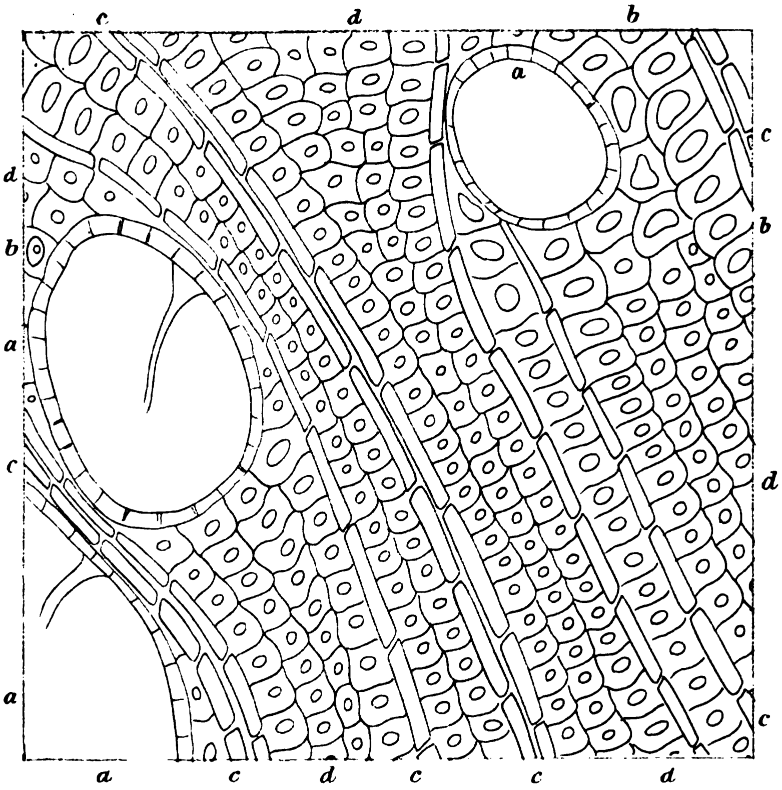

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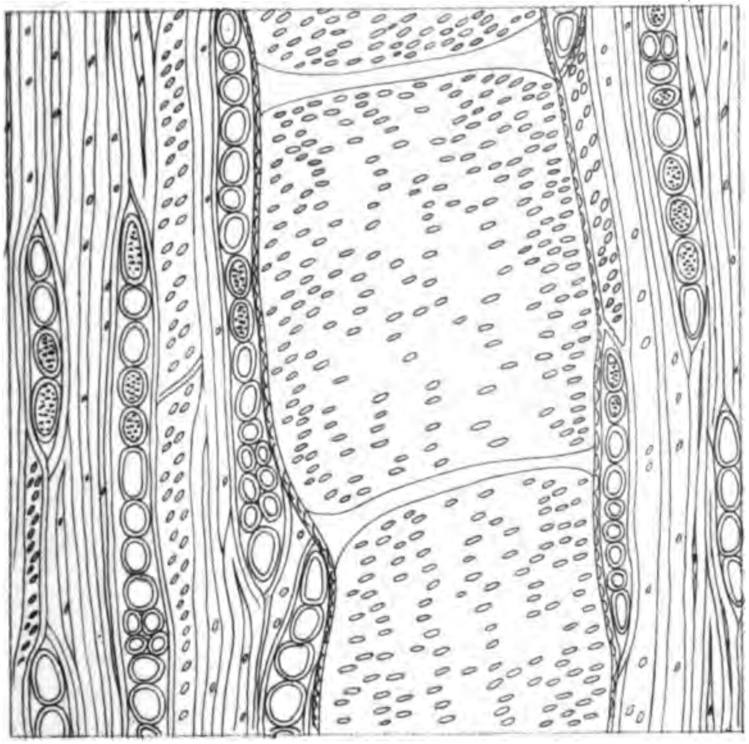

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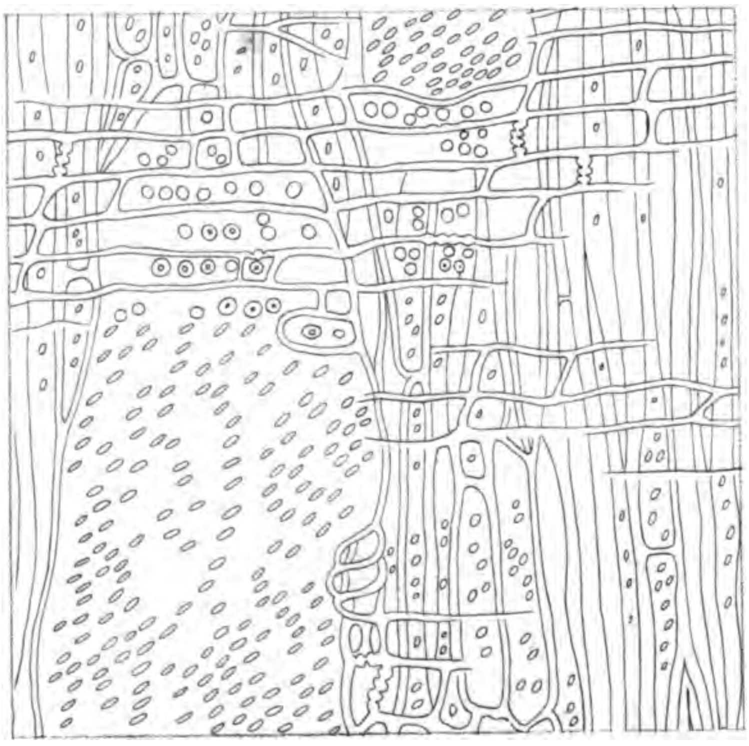

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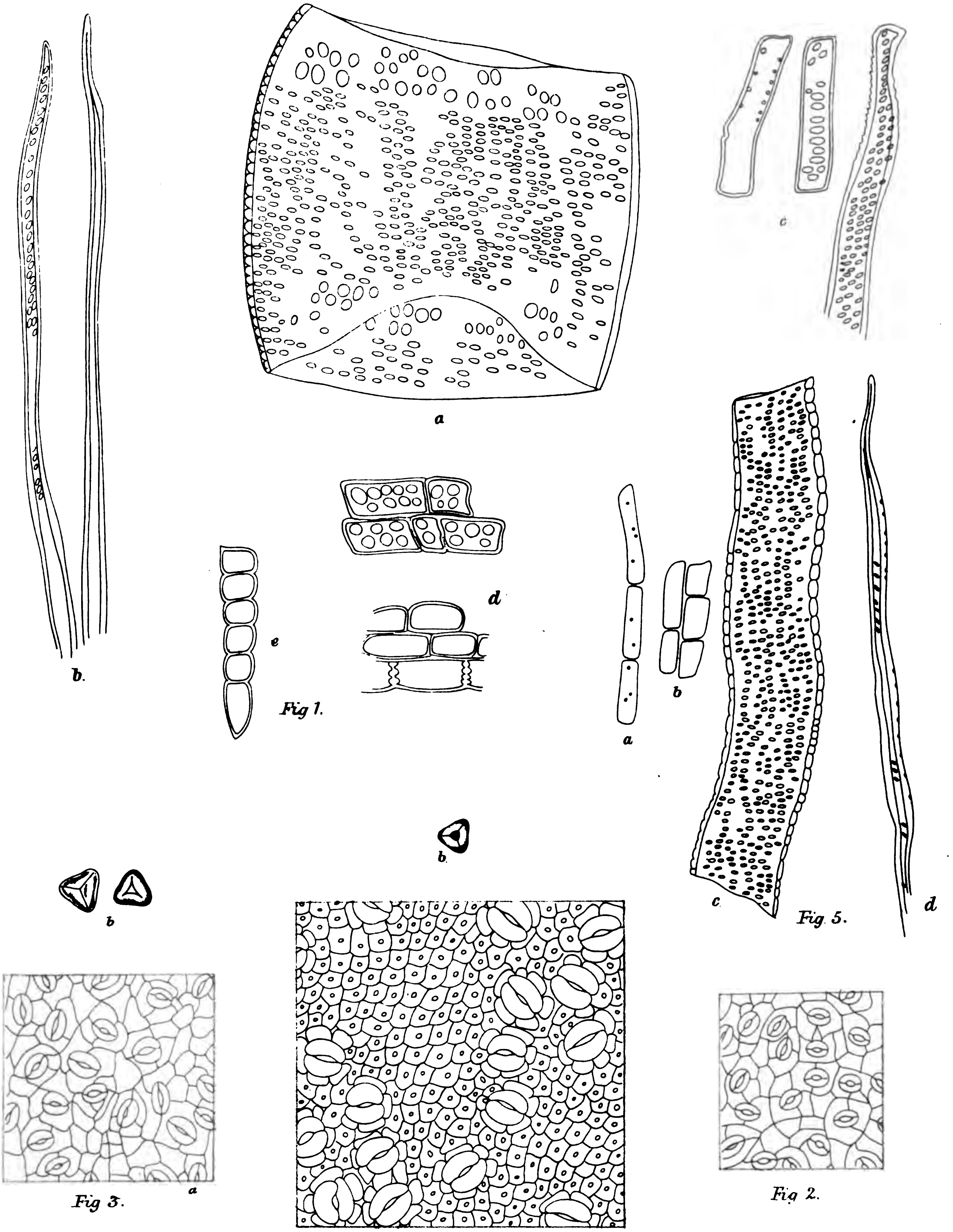

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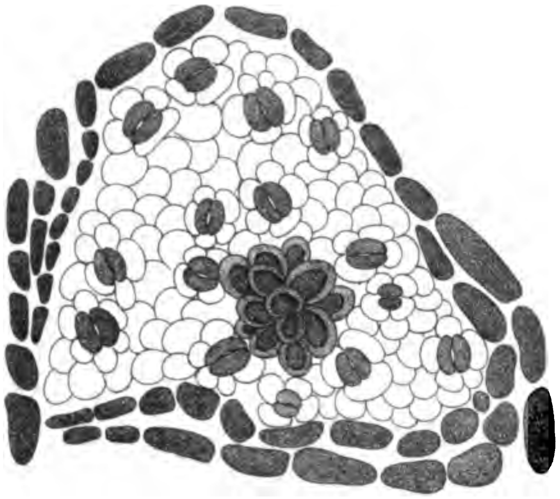

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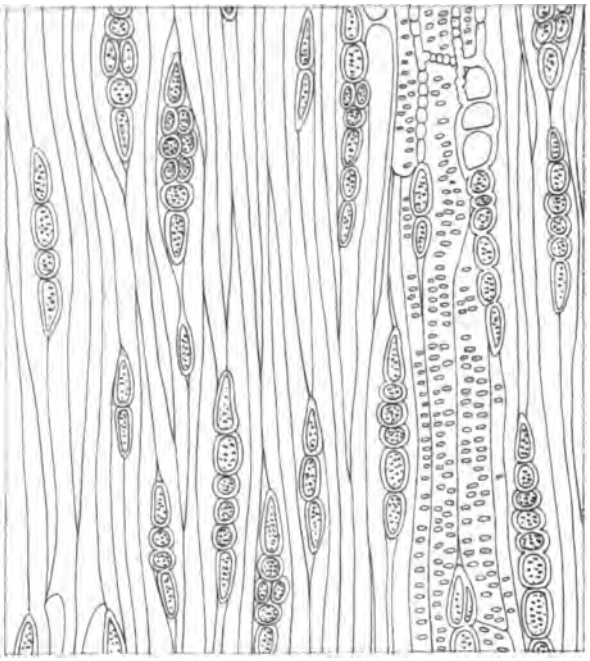

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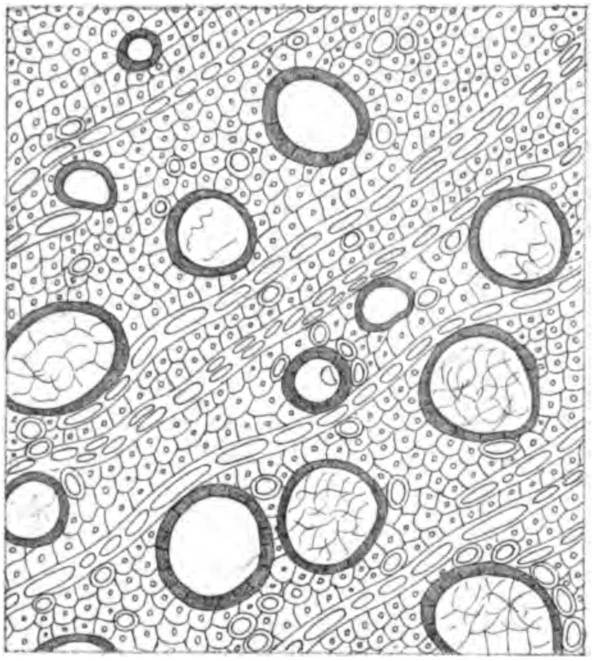

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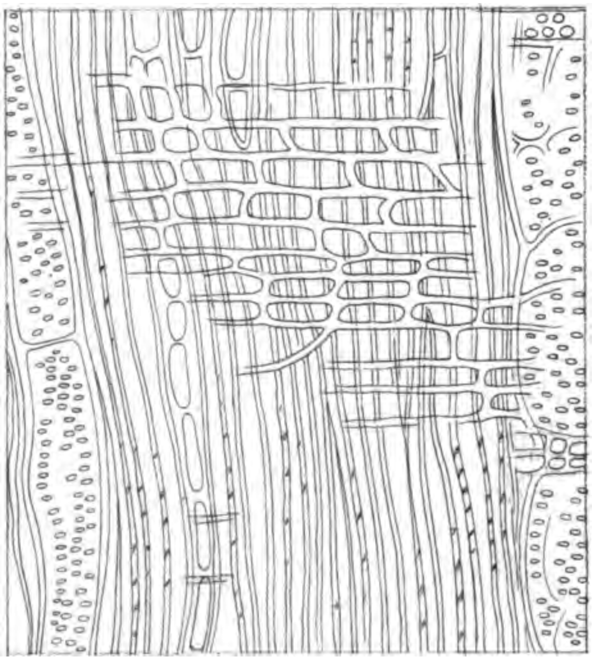

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